ISO 9001:2008
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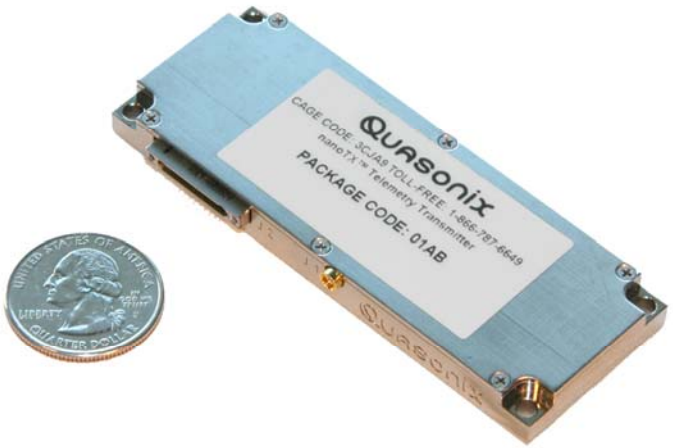
# Installation and Operation Manual

# nanoTX™ Telemetry Transmitter

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# 1 Introduction

## 1.1 Description

This document describes the Installation and Operation of Quasonix' nanoTX™ and nanoPuck™ Multi- mode Digital Telemetry Transmitters. The nanoTX™ and nanoPuck™ are designed to transmit airborne telemetry data from a test article to ground stations. The transmitters are developed, manufactured, and supported by:

**Quasonix, Inc.**
**6025 Schumacher Park Drive**
**West Chester, OH 45069**
**CAGE code: 3CJA9**

### 1.1.1 Nomenclature

The nanoTX™ and nanoPuck™ models are available in a number of variations, depending on the options specified at the time of order. The type of features and modes installed in each unit are identified in the model number, as depicted in Figure 1. Package field codes are listed in Table 11. Detailed information for packages other than 01AA is located in the TIMTER™ Transmitter Packages document, available at the Quasonix web site. For questions about specific packages, please contact Quasonix.

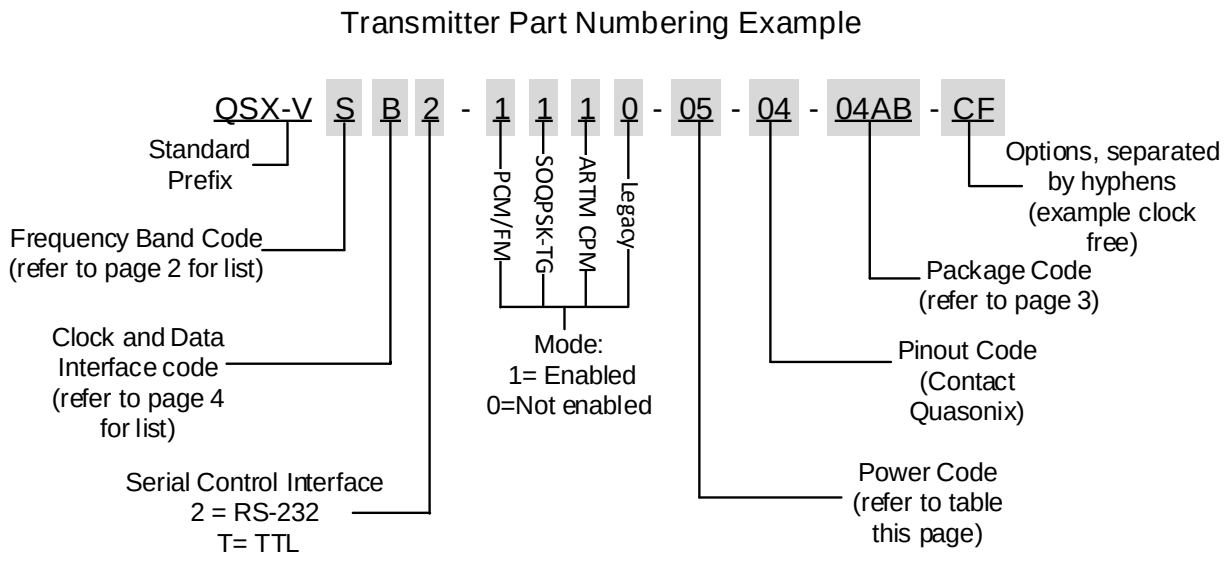

Transmitter Part Numbering Example
QSX-V S B 2 - 1 1 1 0 - 05 - 04 - 04AB - CF
Standard Prefix
Frequency Band Code (refer to page 2 for list)
Clock and Data Interface code (refer to page 4 for list)
Serial Control Interface 2 = RS-232 T= TTL
PCM/FM
SOQPSK-TG
ARTM CPM
Legacy
Mode: 1= Enabled 0=Not enabled
Power Code (refer to table this page)
Pinout Code (Contact Quasonix)
Package Code (refer to page 3)
Options, separated by hyphens (example clock free)

**Figure 1: Model Number Construction Description for nanoTX™ and nanoPuck™**

In this manual, the words Terminal Control and Serial Control have the same meaning and are used synonymously throughout this manual. Serial control originates from configuring the transmitter from a computer's legacy RS-232/422 serial communications (COM) port. Terminal Control reflects the more generic case where the transmitter could be controlled by other standard computer interfaces such as Ethernet.

Information in this manual applies to all nanoTX™ and nanoPuck™ models, unless otherwise specified. Other TIMTER™ transmitter models are covered in separate user manuals, available for download from the company website: www.quasonix.com.

The nanoTX™ and nanoPuck™ are available with the following software and hardware options. Refer to section 1.2 for detailed descriptions of each option.

- AC Automatic carrier wave output
- BRx Non standard baud rate for serial protocol
- C7 IRIG 106-07 control protocol
- CF Clock-free baseband interface
- DP Dual power (Ability to set a low and a high setting, hardware controlled*
- FO Frequency Offset
- GN GPS notch filters to meet 115 dBm in 3 kHz band at L1 and L2 – Include this hardware option with order
- HR Increases max bit rate up to 46 Mbps (23 Mbps for PCM/FM) (20 Mbps max for Clock Free mode)
- ID Internal Clock and Data can be saved as a power-up default
- K7 Convolutional encoder (includes NRZ-M encoding)
- LC Low current in the RF Off state, 10 mA (hardware option)
- LD LDPC forward error correction encoding
- LR Decreases min bit rate to 50 kbps (25 kbps for PCM/FM) (50 kbps min for Clock Free mode)
- MS Modulation scaling
- PS Enable hardware presets (specify 2, 4, 8, or 16 – PS2, PS4, PS8, PS16)
- STDN Supports Spacecraft Tracking and Data Network (PM/BPSK) mode
- VF Variable FIFO Depth
- VP Variable power (32 settings, spanning 24 dB), software controlled*
- WV Wide input voltage range

Refer to Table 16 in section 4.2.1 for detailed descriptions of each option. Due to input connector pin count limitations, certain combinations of options are not available. Please contact Quasonix for support in ordering nanoTX™ options or for information regarding upgrades to nanoTX™ units that you may already own.

The model number identifies the configuration of the unit. For example, model number QSX-VSTT-1100-01-N1-01AA-CF-WV defines a unit configured as follows:

**Table 1: Model Configuration Example**

| Identifiers | Description |
|---|---|
| QSX | Quasonix Product |
| V | Variable bit rate |

| Identifiers | Description |
|---|---|
| S | S band |
| T | TTL clock and data interface |
| T | TTL serial control interface code |
| 1100 | Tier 0 present, Tier I present, Tier II absent, Legacy absent |
| 01 | 1 Watt RF output |
| N1 | Pinout code |
| 01AA | nanoTX™ package code |
| CF | Clock-free baseband interface option |
| WV | Wide Voltage option |

## 1.2 Model Number Field Codes

### 1.2.1 Frequency Band

Frequency band codes are listed in Table 2.

**Table 2: Frequency Band Codes**

| Frequency Band Code | Band | Minimum Frequency | Maximum Frequency | Default Frequency | Tuning Steps |
|---|---|---|---|---|---|
| A | Lower S | 2200.5 | 2300.5 | 2250.5 | 0.5 MHz |
| L | Lower L | 1435.5 | 1534.5 | 1450.5 | 0.5 MHz |
| S | S | 2200.5 | 2394.5 | 2370.5 | 0.5 MHz |
| U | Upper L | 1750.0 | 1855.0 | 1800.5 | 0.5 MHz |

### 1.2.2 Clock and Data Interface

Clock and data interface codes are listed in Table 3.

**Table 3: Clock and Data Interface Codes**

| Clock and Data Interface Code | Baseband Clock and Data Interface |
|---|---|
| H | TTL (10k ohms to ground) |
| L | LVDS (Low Voltage Differential Signal) |
| R | RS-422 (120 ohms differential) |

| Clock and Data Interface Code | Baseband Clock and Data Interface |
|---|---|
| T | TTL (75 ohms to ground) |

### 1.2.3 Serial Control Interface

Serial control interface codes are listed in Table 4.

**Table 4: Serial Control Interface Codes**

| Serial Control Interface Code | Serial Control Interface |
|---|---|
| 2 | RS-232; 57,600 baud rate |
| T | TTL; 57,600 baud rate |

### 1.2.4 ARTM Tier 0 (PCM/FM)

ARTM Tier O codes are listed in Table 5.

**Table 5: ARTM Tier 0 Codes**

| Part Number Code | PCM/FM (ARTM Tier 0) |
|---|---|
| 0 | Absent |
| 1 | Present |

### 1.2.5 ARTM Tier I (SOQPSK-TG)

ARTM Tier I codes are listed in Table 6.

**Table 6: ARTM Tier I Codes**

| Part Number Code | SOQPSK-TG (ARTM Tier I) |
|---|---|
| 0 | Absent |
| 1 | Present |

### 1.2.6 ARTM Tier II (Multi-h CPM)

ARTM Tier II codes are listed in Table 7.

**Table 7: ARTM Tier II Codes**

| Part Number Code | Multi-h CPM (ARTM Tier II) |
|---|---|
| 0 | Absent |
| 1 | Present |

### 1.2.7 Legacy

Legacy modes include BPSK, QPSK, and OQPSK. Legacy codes are listed in Table 8.

**Table 8: Legacy Codes**

| Part Number Code | Legacy Modes |
|---|---|
| 0 | Absent |
| 1 | Present |

### 1.2.8 Output Power

All nanoTX™ models are available with 10 mW to 10 W output power, as shown in Table 9. The nanoPuck™ models are available with 1 W, 2 W, or 5 W output power.

**Table 9: Output Power Codes**

| Power Code | RF Output Power |
|---|---|
| 00 | 10 mW (+10 dBm), minimum |
| 01 | 1 Watt (+30 dBm), minimum |
| 02 | 2 Watt (+33 dBm), minimum |
| 05 | 5 Watt (+37 dBm), minimum |
| 10 | 10 Watt (+40 dBm), minimum |

The input current and standard input voltages for all nanoTX™ and nanoPuck™ models are listed in Table 10.

**Table 10: Power Supply DC Input Current at Standard Input Voltage**

| nanoTX™ Model | Input Current |
|---|---|
| Single band, 10 mWatt | 300 mA max., 250 mA typ. @ 28 VDC |
| Single band, 1 Watt | 450 mA max., 350 mA typ. @ 28 VDC |
| Single band, 2 Watt | 570 mA max., 480 mA typ. @ 28 VDC |

| nanoTX™ Model | Input Current |
|---|---|
| Single band, 5 Watt | 1.0 A max., 800 mA typ. @ 28 VDC |
| Single band, 10 Watt | 1.3 A max., 1.1 A typ. @ 28 VDC |

### 1.2.9 Packages

Package codes are listed in Table 11.

**Table 11: Package Codes**

| Model Number Code | Package Dimensions (Excluding Connectors) |
|---|---|
| 01AX | 1.275 $in^3$ 1.250" x 3.400" x 0.300" (H) |
| 01PX | 1.280 $in^3$ 2.300" (Dia) x 0.325" (H) |

### 1.2.10 Automatic Carrier Wave Output Option - AC

This option allows the TIMTER™ to transmit a carrier wave when the clock input is absent, which would normally cause the RF output to be turned off.

### 1.2.11 Baud Rate Option – BRx

The BR option changes the serial communications default baud rate on the transmitter to the one selected. A number from 0-7 follows the BR option request. Corresponding values are as follows: 0 = 57600; 1 = 4800; 2 = 9600; 3 = 19200; 4 = 38400; 5 = 56000; 6 = 57600; 7 = 115200.

### 1.2.12 CP07 Control Protocol Option – C7

The IRIG 106-07 control protocol (CP07), Appendix N "provides standards for commands, queries, and status information when communicating with telemetry transmitters configured with communication ports." The Basic command set contains the minimum (required) commands for transmitter control, query, and status. The Extended command set contains optional commands that may or may not be implemented at the manufacturer's discretion. CP07 is enabled when the C7 option is requested.

The default baud rate for CP07 transmitters is 9600.

### 1.2.13 Convolutional Encoder Option – K7 (formerly CE option)

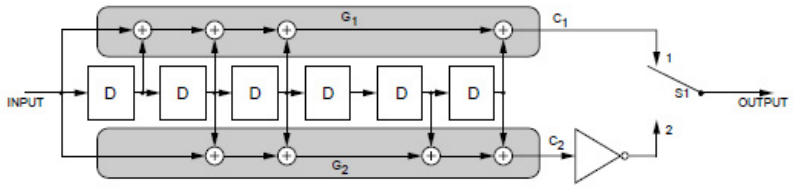
The CE option enables convolutional encoding and NRZ-M conversion. This encoding adds redundant information to the transmitted data stream to help detect and correct bit errors that may occur, particularly due to predominantly Gaussian noise. Use of convolutional encoding requires a matching Viterbi decoder in the receiver to extract the source data. The encoded data rate will be twice the source data rate, and the occupied bandwidth will also be doubled.

For example, the transmitter has two encoders, one for in-phase ("I") data and one for quadrature ("Q") data. Call the input symbol stream I0/Q0, I1/Q1, … . Each encoder outputs 2 bits for every input bit, so call the output bit stream from the first convolutional encoder I0(1), I0(2), I1(1), I1(2), … , and call the output bit stream from the second convolutional encoder Q0(1), Q0(2), Q1(1), Q1(2), … . Combining the outputs of the two encoders, then, the output symbol stream is I0(1)/Q0(1), I0(2)/Q0(2), I1(1)/Q1(1), I1(2)/Q1(2), … .

For modes that do not employ Quadrature modulation, such as PCM/FM, Multi-h CPM, and BPSK, only a single encoder is used.

A single encoder is implemented exactly as described in the "Consultative Committee for Space Data Systems, Recommendation for Space Data System Standards, TM Synchronization and Channel Coding, CCSDS 131.0-B-1, Blue Book, September 2003, Section 3."

A basic convolutional encoder block diagram, as illustrated in CCSDS 131.0-B1, is shown in Figure 2.




NOTES:

1. → D → = SINGLE BIT DELAY.
2. FOR EVERY INPUT BIT, TWO SYMBOLS ARE GENERATED BY COMPLETION OF A CYCLE FOR S1: POSITION 1, POSITION 2.
3. S1 IS IN THE POSITION SHOWN (1) FOR THE FIRST SYMBOL ASSOCIATED WITH AN INCOMING BIT.
4. ⊕ = MODULO-2 ADDER.
5. → ▷○ = INVERTER.

**Figure 3-1: Basic Convolutional Encoder Block Diagram**

"Consultative Committee for Space Data Systems, Recommendation for Space Data System Standards, TM Synchronization and Channel Coding, CCSDS 131.0-B-1, Blue Book, September, 2003," page 3-2.

**Figure 2: CCSDS 131.0-B-1 Rendering of Basic Convolutional Encoder Diagram**

### 1.2.14 Clock-free Baseband Interface Option – CF

Clock-free is an optional mode that transmits user data, but uses an internal bit sync to take the place of the normal external clock. The standard TIMTER™ requires external clock and data inputs. With the CF option, no external clock is required. The clock is generated directly from the data and a user-specified bit rate.

Because the internal bit sync's clock takes the place of the normal external clock in clock-free mode, the selected clock source must be external for clock-free just like it is for normal clock/data. This mode is most often use to retrofit older analog transmitters in TM systems where the crypto does not deliver a clock to the transmitter.

The commanded clock-free rate can be saved, and it will be restored at power-on. When the CF option is used, the bit rate range is 0.1 to 35 Mbps for all waveform modes. It is limited by the bit rate achievable for the current mode. (Refer also to the HR and LR options for extended bit rates, and the ID option for Internal Clock and Data.)

Do not confuse the **CF option** with CS/DS **commands**.

Internal clock (CS 1 Command) is used when the transmitter is to be a test source only. The unit transmits the selected internal data pattern (DS 1 command) at the bit rate set by the user via the IC command. The internal clock is not used to transmit actual payload data.

External clock (CS 0 Command) is the normal mode: the user supplies clock and data. Refer to Table 16 for user commands.

### 1.2.15 Dual Power Option – DP

The standard TIMTER™ operates at its full rated RF output power. The DP option provides two software-programmed, hardware-actuated settings, designated by the user as “high power” and “low power”. There are 32 choices for “high power” and 32 choices for “low power”. The low power setting can provide as much as 24 dB of attenuation from the high power setting.

### 1.2.16 Frequency Offset Option – FO

This option is used to set frequencies that are NOT aligned to the synthesizer step size for their units, typically 500 kHz, and it enables the FO user command.

### 1.2.17 GPS Notch Option – GN

Use this option to specify GPS notch filters to meet 115 dBm in 3 kHz band at L1 and L2 (hardware note). Available for S band only. Consult Quasonix for pricing and availability.

### 1.2.18 High Bit Rate Option – HR

The standard nanoTX™ supports bit rates from 0.1 to 28 Mbps in SOQPSK-TG and MULTI-h CPM modes, 0.05 to 14 Mbps in PCM/FM (Tier 0) mode and in all modes included with the PSK option. The HR option increases the bit rate to a maximum of 46 Mbps (23 Mbps for PCM/FM). (The maximum bit rate with a Clock Free transmitter is 35 Mbps for SOQSPK-TG and MULTI-h CPM modes; 23 Mbps for PCM/FM and all legacy PSK modes.) Refer to the CF option for information about the Clock Free option. Refer to Table 12 for bit rate comparisons by mode.

**Table 12: Standard Bit Rates Compared to Low/High Rate Options**

| | Standard Bit Rate | With Low Rate Option -LR | With High Rate Option -HR |
|---|---|---|---|
| **ARTM Tier 0 Modulation (PCM/FM)** | 0.05 -14 Mbps | Down to 0.025 Mbps | Up to 23 Mbps |
| **ARTM Tier I Modulation (SOQPSK-TG)** | 01 - 28 Mbps | Down to 0.050 Mbps | Up to 46 Mbps |
| **ARTM Tier II Modulation (Multi-h CPM)** | 01 - 28 Mbps | Down to 0.050 Mbps | Up to 36 Mbps |
| **Legacy Modulation (BPSK)** | 0.05 - 10 Mbps | N/A | N/A |
| **Legacy (QPSK, OQPSK)** | 0.05 - 20 Mbps | N/A | N/A |

### 1.2.19 Internal Clock and Data Option – ID

The ID option allows the CS and DS user settings to be reloaded on power up or on a manual recall of a setup. Without the ID option, CS and DS are both forced to 0. Refer to the CF option for information about the Clock Free option.

### 1.2.20 Limited Current Option - LC

This option is used to specify low current in the RF Off state. Current draw is less than 10 mA when the transmitter is Off. This is a hardware pin option.

### 1.2.21 Forward Error Correction / Low Density Parity Check (LDPC) Option – LD

This option provides the Low Density Parity Check (LDPC) encoding, which is being considered for use on the iNET program.

### 1.2.22 Low Bit Rate Option – LR

The standard nanoTX™ supports bit rates from 0.1 to 28 Mbps in SOQPSK-TG and MULTI-h CPM modes, 0.05 to 14 Mbps in PCM/FM (Tier 0) mode and in all modes included with the PSK option. The LR option decreases the bit rate to a minimum of 50 kbps (25 kbps for PCM/FM). (The minimum bit rate with a Clock Free transmitter is 50 kbps for all modes.) Refer to the CF option for information about the Clock Free option. Refer to Table 12 for bit rate comparisons by mode.

### 1.2.23 Modulation Scaling Option – MS

This option enables the MS and MJ commands which allow a user to set the modulation scaling factor and scale the modulation index of the transmitted signal. For additional information, refer to Table 16, or contact Quasonix.

### 1.2.24 Hardware Preset Option – PS2, PS4, PS8, or PS16

The TIMTER™ supports one or more hardware presets. A single preset defines the complete state of the transmitter, including carrier frequency, modulation mode, data polarity, randomizer state, etc. Without the PS option, the TIMTER™ supports only one hardware preset, which it reverts to at power-up. The PS in the option string specifies that the unit supports multiple hardware presets (2, 4, 8, or 16). Presets are engaged by grounding various combinations of pins on the terminal/parallel control selection. The number of presets available and which pins engage the presets depend on the other features specified. Due to the limited number of pins available, the PS option may require the elimination of the RF On/Off pin. Due to firmware part number parsing requirements, the hardware preset option code must be at the very end of the part number to be valid. On units which use the standard MDM-15 connector, the ZY command displays the connector pinout showing preset pin locations.

### 1.2.25 Spacecraft Tracking and Data Network Option – STDN

This option supports the PM/BPSK mode (Spacecraft Tracking and Data Network mode).

### 1.2.26 Variable FIFO Depth Option – VF

This option enables the VF command which allows the user to set the FIFO depth on the transmitter for controlling latency time between bits in and bits out. The range is 0 to 255 with 128 being the default. If no value is entered, the current value displays.

### 1.2.27 Variable Power Option – VP

The standard TIMTER™ operates at its full rated RF output power. The software-based VP option provides 32 discrete power level settings, spanning a range of as much as 24 dB. The steps are non-uniform, but steps are typically no larger than 1.1 dB.

### 1.2.28 Wide Input Voltage Range Option – WV

The standard nanoTX™ operates from +28 ± 4 VDC. The WV option extends operating input voltage range as shown in following table.

| Voltage Ranges with WV Option |
|---|
| +6.5 to +34 VDC for 10 mWatt version |
| +6.5 to +34 VDC for 1 Watt version |
| +6.5 to +34 VDC for 2 Watt version |
| +12 to +34 VDC for 5 Watt version |
| +21 to +34 VDC for 10 Watt version |

# 2 Accessories

Quasonix offers a number of optional accessories for the nanoTX™ transmitter, including a fan-cooled heat sink, 15 pin Nano-D and 21 pin Nano-D connectors, complete Nano-D cable assemblies, an MMCX to SMA cable, a ruggedized handheld programmer, and a USB to serial converter cable. Contact Quasonix for pricing and availability of nanoTX™ accessories.

## 2.1 Fan-cooled Heat Sink

Part Number: QSX-AC-32-HS-12V

The heat sink assembly includes an integral +12 VDC fan and a power supply transformer, shown in Figure 3. The heat sink is shown with a mounted nanoTX™ in Figure 4.

**Figure 3: Fan-cooled Heat Sink and Power Supply**

**Figure 4: Fan-cooled Heat Sink with nanoTX™**

## 2.2 Pre-wired 15 Pin Nano-D TTL Connector

Part Number: QSX-AC-NANO15-36PT

A 15 pin Nano-D connector with 36” color-coded pigtail is shown in Figure 5.

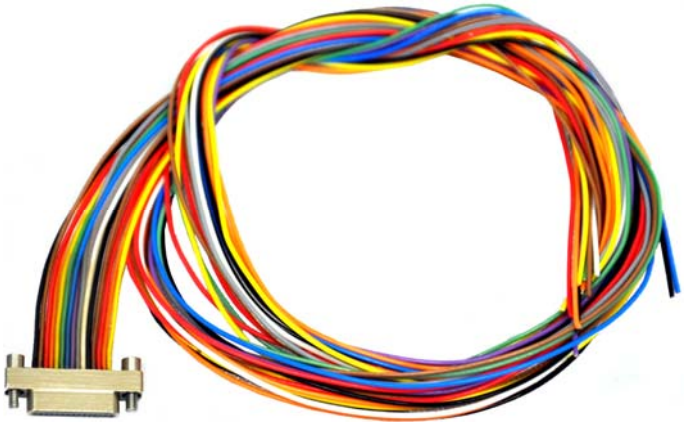


**Figure 5: Pre-wired 15 Pin NANO-D with 36" Pigtails**

## 2.3 Pre-wired 21 Pin Nano-D

Part Number: QSX-AC-NANO21-36PT

A 21 pin Nano-D connector with 36” color-coded pigtail cables is shown in Figure 6.

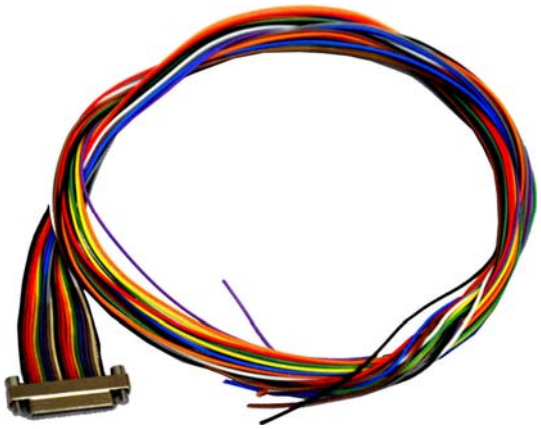


**Figure 6: Pre-wired 21 Pin Nano-D with 36" Pigtails**

## 2.4 15 Pin Nano-D Wiring Harness

Part Number: QSX-AC-NANO15-HARNESS

A 15 pin Nano-D wiring harness for connecting to transmitters with TTL clock and data baseband interface is shown in Figure 7. It includes banana plugs for power and ground, BNC connectors for clock and data, and a DB-9 connector for serial control.

**Figure 7: 15 Pin Nano-D Cable Harness**

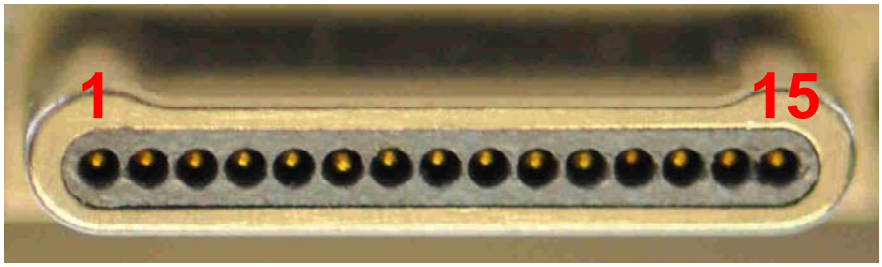



**Figure 8: 15 Pin Nano-D Cable Harness Pins**

## 2.5 21 Pin Nano-D Wiring Harness

Part Number: QSX-AC-NANO21-HARNESS

A 21 pin Nano-D wiring harness for connecting to transmitters with RS-422 clock and data baseband interface is shown in Figure 9. It includes banana plugs for power and ground, BNC connectors for clock and data, and a DB-9 connector for serial control.

**Figure 9: 21 Pin Nano-D Cable Harness**

## 2.6 MMCX to SMA Adapter Cable

Part Number: QSX-AC-MMCX-SMA-R-R-34

A 34 mm long MMCX to SMA adapter cable with an RG-316 coax connector, right angle MMCX, and right angle SMA, is shown in Figure 5.

**Figure 10: MMCX to SMA Adapter Cable**

## 2.7 Ruggedized Handheld Programmer

Part Number: QSX-AC-HHPROG-800N-Y

The handheld programmer is an ultra-rugged Pocket PC with custom Quasonix software that allows the user to configure transmitters through its serial interface directly in the field. The programmer is shown in Figure 11.

**Figure 11: Ruggedized Handheld Programmer**

## 2.8 USB to Serial Converter Cable

Part Number: QSX-AC-USBSER-CONV

The USB to serial converter cable allows for configuration of the transmitter with a computer that does not have a serial port. The cable is pictured in Figure 12.

**Figure 12: USB to Serial Converter Cable**

# 3 Installation Instructions

## 3.1 Mechanical

### 3.1.1 01AA Package

The 01AA package, shown in Figure 13, measures 1.250" x 3.400" x 0.300" and provides a TTL interface. It uses a female 15 Pin nano interface connector and a female MMCX RF connector.

The standard 1.3 cubic inch nanoTX™ ("01AA" package) is designed to be mounted by four (4) 4-40 screws through the holes in the four corners, as depicted in Figure 14.

**Figure 13: 1.275 in$^3$ nanoTX™ – 01AA Package**

The pin assignments for the 01AA package are listed in Table 13. These pin assignments can change, depending on the options selected. Consult Quasonix for details. Additional package information is presented in the document "TIMTER™ Transmitter Packages" on the Quasonix web site.

**Table 13: nanoTX™ 01AA Pin Assignments**

| Pin | Function |
|---|---|
| 1 | Serial Control Ground |
| 2 | Serial Control Reply from Transmitter |
| 3 | Control Input to Transmitter |
| 4 | N/C |
| 5 | N/C |
| 6 | TTL Data |
| 7 | TTL Clock |
| 8 | TTL Clock and Data Ground |
| 9 | RF On/Off |
| 10 | DC Power Return |
| 11 | DC Power Return |
| 12 | DC Power Return |
| 13 | DC Power In |
| 14 | DC Power In |
| 15 | DC Power In |

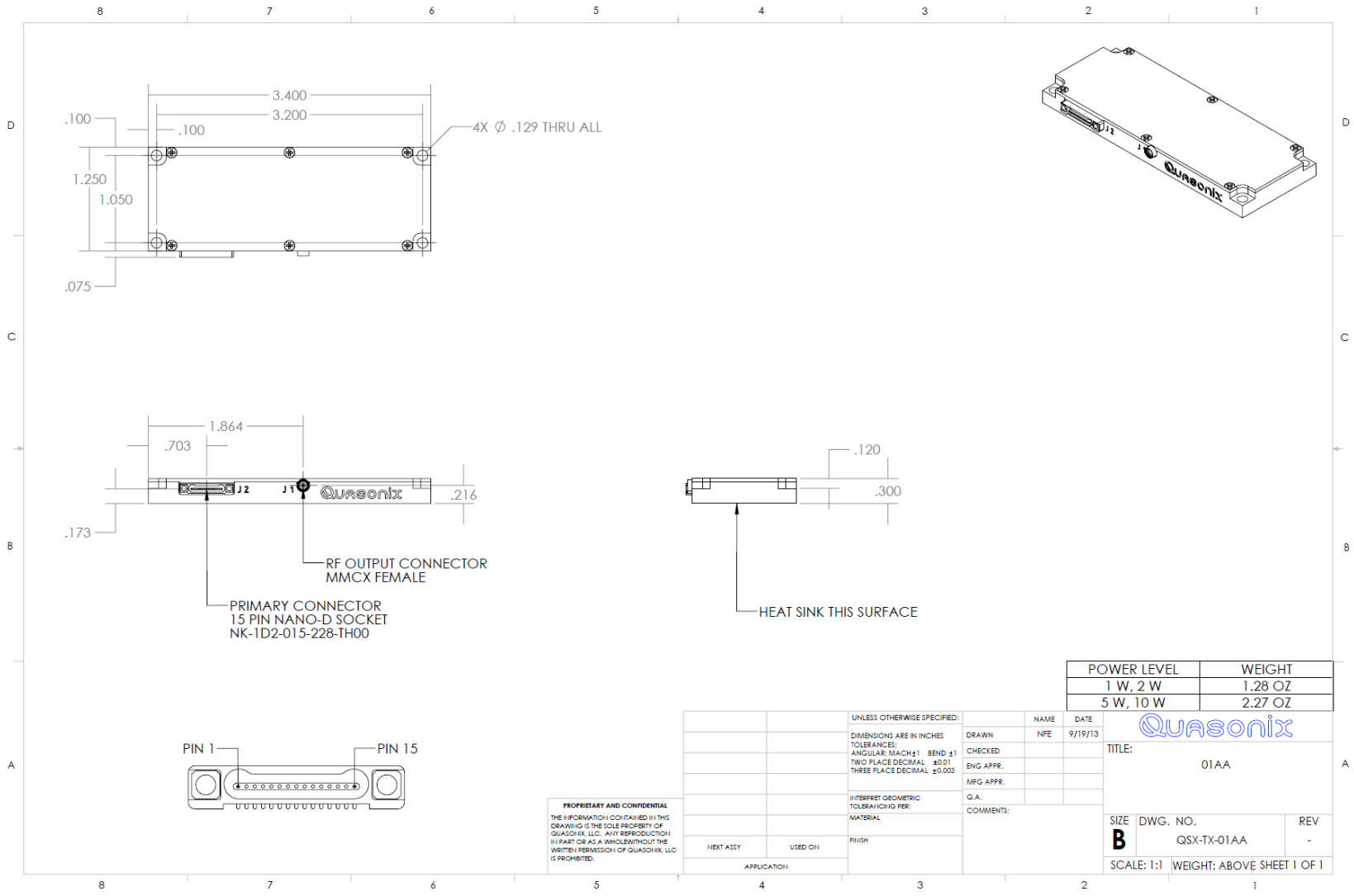



**Figure 14: Outline Drawing, nanoTX™ Telemetry Transmitter – 01AA Package**

### 3.1.2 01AB Package

The 01AB package, shown in Figure 15, measures 1.250" x 3.400" x 0.300" and provides an RS-422 interface. It uses a female 21 Pin nano interface connector and a female MMCX RF connector.

**Figure 15: 1.275 in$^3$ nanoTX™ - 01AB Package**

The pin assignments for the 01AB package are listed in Table 14. These pin assignments can change, depending on the options selected. Consult Quasonix for details. Additional package information is presented in the document "TIMTER™ Transmitter Packages" on the Quasonix web site.

**Table 14: nanoTX™ 01AB Pin Assignments**

| Pin | Function |
|---|---|
| 1 | Serial Control Ground |
| 2 | RS-232 Serial Control Reply |
| 3 | RS-232 Serial Control Input |
| 4 | N/C |
| 5 | N/C |
| 6 | Differential Data Positive |
| 7 | Differential Clock Positive |
| 8 | DC Power Return |
| 9 | RF On/Off |
| 10 | DC Power Return |
| 11 | DC Power Return |
| 12 | DC Power Return |
| 13 | DC Power In |
| 14 | DC Power In |
| 15 | DC Power In |
| 16 | N/C |
| 17 | N/C |
| 18 | N/C |
| 19 | N/C |
| 20 | Differential Data Negative |
| 21 | Differential Clock Negative |

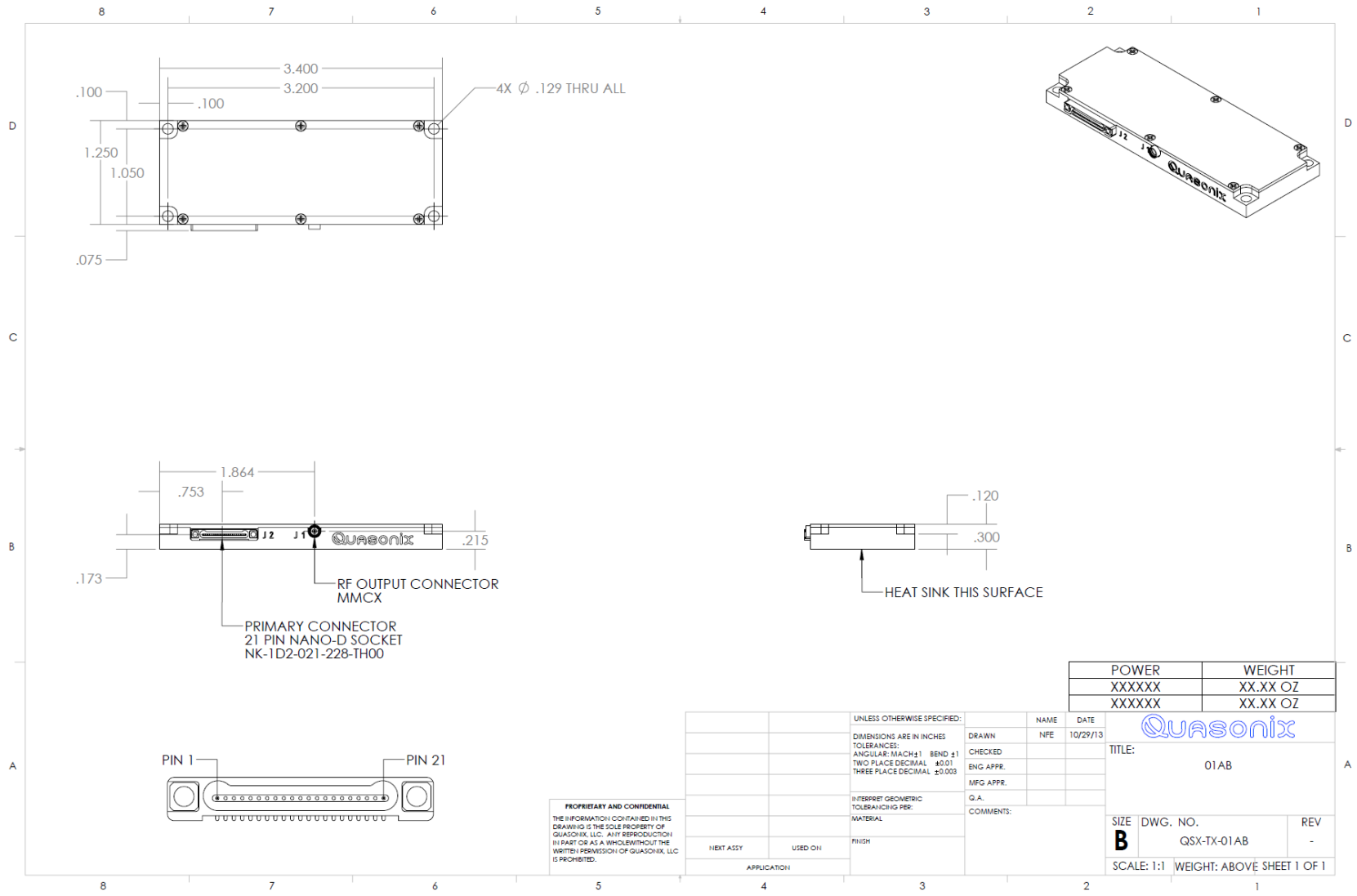



**Figure 16: Outline Drawing, nanoTX™ Telemetry Transmitter – 01AB Package**

## 3.2 Thermal

It is important that the bottom surface (on the face opposite the product label) be securely attached to a baseplate capable of dissipating the power produced by the transmitter model in use. This mounting baseplate must be flat, smooth, and clean. Contact Quasonix for the heat sink power dissipation required for your nanoTX™ model.

**ATTENTION: Do not operate the transmitter without a proper heat sink. Failure to do so may lead to permanent damage to the unit and will void the warranty.** Overheating can occur in a matter of seconds when a transmitter is not properly heat-sinked. In absolutely no case should any type of stickers or labels be applied to the bottom surface of the transmitter.

The heat sink required for a particular transmitter depends heavily on the installation. Factors such as altitude, air temperature, air flow, and mass of the mounting surface all have a substantial impact on the flow of heat away from the transmitter. Quasonix offers a fan-cooled heat sink, as shown in Figure 3. Please contact Quasonix for heat sink recommendations for your particular nanoTX™ transmitter.

Regardless of the heat sink, Quasonix strongly suggests using a thermal pad, such as Tpcm™ 583 from Laird Technologies.

## 3.3 Electrical

The standard nanoTX™ has two external connectors, a 15- or 21-pin single-row nano-D baseband connector, and a right-angle through-hole MMCX RF connector. The 15-pin nano-D is only available for TTL-level clock and data inputs (standard 01AA package). RS-422 clock and data inputs require the 21-pin nano-D connector (01AB package).

A diagram of the 15-pin nano-D connector is shown in Figure 6, including identification of pin 1 and pin 15.

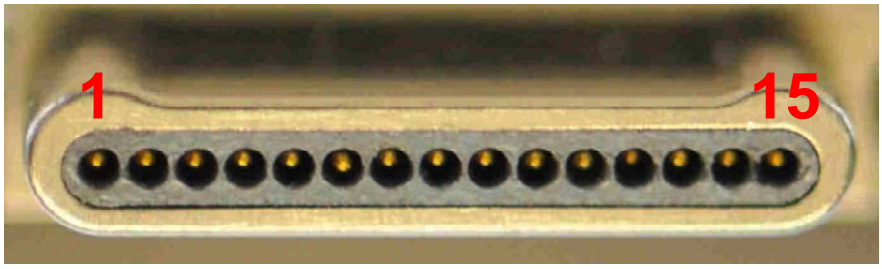



**Figure 17: 15-pin Nano-D Connector**

### 3.3.1 TTL Clock and Data Baseband

The pin assignments of the TTL clock and data baseband connector are outlined below. TTL baseband connector pinouts are listed in Table 15.

**Table 15: TTL Baseband Connector Pinout**

| Pin | Function | Notes |
|---|---|---|
| 1 | Serial Control Ground | Ground to controller |
| 2 | Serial Control Reply (Transmitter TXD) | Replies from TX to controller |
| 3 | Serial Control Input (Transmitter RXD) | Commands from controller to TX |
| 4 | No Connection | |
| 5 | No Connection | |
| 6 | TTL Data | TTL data input |
| 7 | TTL Clock | Synchronous with data, data valid on falling edge |
| 8 | TTL Data/ClockGround | |
| 9 | RF On / Off | |
| 10 | Power Ground | |
| 11 | Power Ground | |
| 12 | Power Ground | |
| 13 | Power +28 VDC +/- 4 VDC | Refer to Table 17: DC Input Current at Standard Input Voltage |
| 14 | Power +28 VDC +/- 4 VDC | |
| 15 | Power +28 VDC +/- 4 VDC | |

#### 3.3.1.1 Pin Information

Pin 1 is the ground connection to the serial control device. This pin is connected internally to pin 8, and pins 10, 11, and 12, making the transmitter the central ground connection for the control device, the data/clock source, and power.

Pin 2 carries the responses from the transmitter to the serial control device. This information is ASCII text, at RS-232 levels, at 57,600 baud, 8 bits, no parity, 1 stop bit, no handshaking.

Pin 3 carries the commands from the serial control device to the transmitter. This information is ASCII text, at RS-232 levels, at 57,600 baud, 8 bits, no parity, 1 stop bit, no handshaking.

Pins 4, 5, and 9 are available to support optional features.

Pin 6 is TTL input data. Input impedance is 10k ohms to ground (optionally 75 ohms). The transmitter reads the data pin on the clock falling edge.

Pin 7 is TTL input clock. Input impedance is 10k ohms to ground (optionally 75 ohms). The transmitter reads the data pin on the clock falling edge.

Pin 8 is the ground connection to the clock and data source. This pin is connected internally to pin 1, and pins 10, 11, and 12, making the transmitter the central ground connection for the control device, the data/clock source, and power.

Pin 9 is normally a single bit input that turns on or off the RF output power. This pin is pulled high internally. Refer to the RF and RZ commands in Table 16.

Pin 10 is the ground connection to the DC power source. This pin is connected internally to pin 1, pin 8, and pins 11 and 12, making the transmitter the central ground connection for the control device, the data/clock source, and power.

Pin 11 is the ground connection to the DC power source. This pin is connected internally to pins 1, 8, 10, and 12, making the transmitter the central ground connection for the control device, the data/clock source, and power.

Pin 12 is the ground connection to the DC power source. This pin is connected internally to pins 1, 8, 10, and 11, making the transmitter the central ground connection for the control device, the data/clock source, and power.

Pin 13 is the positive connection to the DC power source. Pins 13, 14, and 15 are tied together internally. Refer to Table 17.

Pin 14 is the positive connection to the DC power source. Pins 13, 14, and 15 are tied together internally.

Pin 15 is the positive connection to the DC power source. Pins 13, 14, and 15 are tied together internally.

### 3.3.2 Signal Timing

The data is sampled on the falling edge of the clock, as shown in Figure 18.

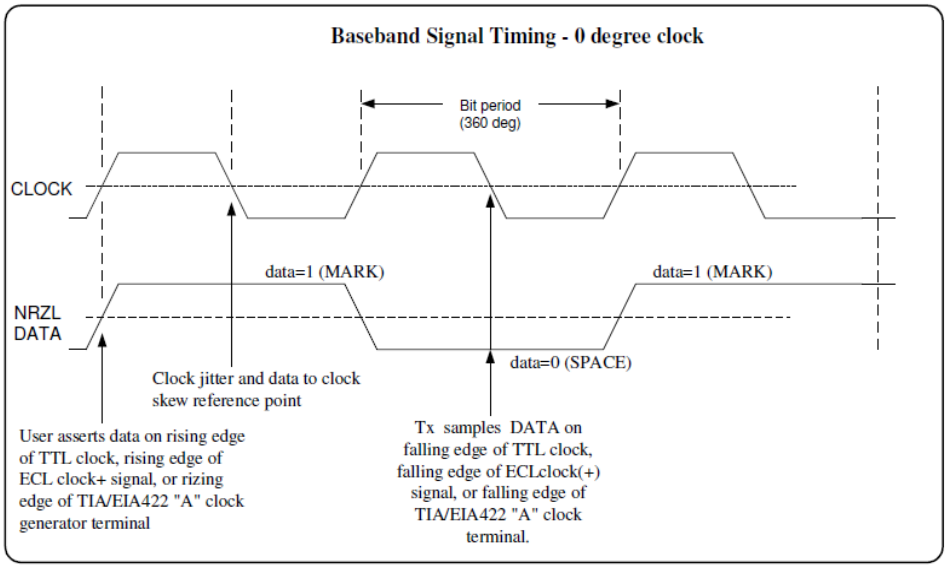



**Figure 18: Baseband Signal Timing**

# 4 Operating Instructions

## 4.1 Power-on Operation

Upon power up, the transmitter loads any stored parameters present in its nonvolatile memory. If parameters have not been stored previously, the transmitter initializes default parameters and then stores them in the first preset slot, 0. There are a total of 16 available software-based presets (0 through 15) for saving multiple parameters at once for future use.

## 4.2 nanoTX™ Serial Control Protocol

The nanoTX™ is controlled via a simple three-wire serial interface (transmit, receive, and ground). The serial port configuration is as follows:

- 57600 baud rate (changeable depending on the configuration option)
- 8 bits
- No parity
- 1 stop bit
- No flow control

For setup and configuration via a standard Windows-based PC, you may use HyperTerminal. For a more flexible, full-featured control interface, we recommend Terminal, available for download from the Quasonix website: http://www.quasonix.com/uploads/terminal_v1-9b.zip.

If the terminal program is active when power is applied to the transmitter, the following welcome message displays, as shown in Figure 19. At this point, you can verify that your serial connection is active in both directions by issuing any standard command, such as “FR” to learn the frequency.

```
Quasonix Multi-mode Digital Transmitter

Customer Part # = QSX-xxx-xx-xx…
Customer Name = Quasonix Customer
Contract # = 999999-9
TX Serial # = 99999999
Hardware Rev: B
PA Rev: No PA
IRIG 106-09
6025 Schumacher Park Drive
West Chester, OH 45069
(513) 942−1287
www.Quasonix.com
CAGE CODE: 3CJA9
FPGA version:  0x07110004
Firmware version: V2.116  5/22/2009
```

**Figure 19: nanoTX™ Welcome Message**

### 4.2.1 Command Set: Standard and Optional Commands

All standard user commands in Table 16 are one or two alphabetic characters, followed by 0, 1, or 2 arguments. If the command is issued with arguments, there must be a space after the alphabetic characters. The commands are *not* case sensitive. A carriage return is required to initiate each command except for the single key commands described at the beginning of the table.

Most parameters set by these commands are stored in the unit's nonvolatile flash memory (CS and DS are the exception). On power-up, ALL settings are restored from preset 0, which is the default power on configuration.

All settings can be changed via the serial control port. Changes made by the user are NOT saved unless the Save command (SV) is issued from the serial control port before powering down.

***SV Note:** Users may save internal clock and data in presets for bench debug use BUT on a power up or when a *hardware* preset is restored, **CS** and **DS** will be forced to **0** (external clock and data). This action prevents a transmitter from powering up or changing hardware presets and being set to internal clock and/or data. The ONLY way to restore CS and/or **DS** as **1** from a saved configuration is by executing the **RC** command.

**Table 16: Standard and Optional User Commands**

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| [ | Frequency Step Down | Left square bracket key retunes the transmitter to the next lower frequency, as determined by the frequency step (FS) parameter<br>Reply to the control window is the new frequency, in MHz<br>**No Enter key required** | Standard | N/A | N/A |
| ] | Frequency Step Up | Right square bracket key retunes the transmitter to the next higher frequency, as determined by the frequency step (FS) parameter<br>Reply to the control window is the new frequency, in MHz<br>**No Enter key required** | Standard | N/A | N/A |
| ? | Help | Displays abbreviated list of available commands<br>**No Enter key required** | Standard | N/A | N/A |
| < | Step Down Power | Incrementally steps down the output power level, from 31 down to 0<br>One step per key press<br>**No Enter key required** | VP | N/A | N/A |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| > | Step Up Power | Incrementally steps up the output power level, from 0 up to 31<br>One step per key press<br>**No Enter key required** | VP | N/A | N/A |
| AC | Automatic Carrier Output | Report or set automatic carrier output state<br>With automatic carrier ON (AC 1), the unit will output an unmodulated, on-frequency carrier if there is no clock present. When automatic carrier is OFF (AC 0), the RF output will be muted in the absence of clock. Note that the AI, CF, and CS commands can create a clock, even when one is not externally applied.<br>Examples:<br>AC Report the automatic carrier state<br>AC 0 Set automatic carrier OFF<br>AC 1 Set automatic carrier ON | AC | Y | AC 1 |
| BR | Bit Rate | Report or set the bit rate of the bit sync that is locking to the externally applied data<br>Not to be confused with “IC”, which sets the rate of the internally generated clock<br>Bit rate range is 50 kbps to 20 Mbps for all waveform modes<br>Examples:<br>BR Report the bit rate<br>BR 5 Set the bit rate to 5 Mbps<br>BR A Set the bit rate automatically | CF | Y | BR 5 |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| CC | Convolutional Encoder | Enables or disables the convolutional encoder<br><br>Examples<br>CC Report convolutional encoder state<br>CC 0 Set the convolutional encoder to Disabled<br>CC 1 Set the convolutional encoder to Enabled | K7 | Y | CC 0 |
| CF | Clock Free | Report or set the clock free state.<br><br>Examples:<br>CF Report the clock free state<br>CF 0 Unit uses its internal bit sync (internally synthesized)<br>CF 1 Unit uses its externally applied clock | CF | Y | CF 1 |
| CP | Clock Polarity | Report or set clock polarity<br><br>Examples:<br>CP Display the current clock polarity<br>CP 0 Set clock polarity to NOT inverted<br>CP 1 Set clock polarity to inverted<br>CP A Set clock polarity to auto; Automatically selects the most reliable clock edge | Standard | Y | CP 0 |
| CR | Current Preset Read | Reports the currently selected software preset being used by the transmitter | Standard | N/A | N/A |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| CS | Clock Source | Report or set the clock source<br>Unit always reverts to CS 0 (external) at power-up<br><br>Examples:<br>CS Display the current clock source<br>CS 0 Set clock source to external<br>CS 1 Set clock source to internal<br><br>When set to internal clock source, the data source must also be set to internal via the DS command in order to have synchronous, usable data. | Standard | N | CS 0 |
| DE | Differential Encoding | Report or set differential encoding for the SOQPSK-TG mode<br><br>Examples:<br>DE Report the differential encoding setting<br>DE 0 Set differential encoding OFF<br>DE 1 Set differential encoding ON | Standard | Y | DE 0 |
| DP | Data Polarity | Report or set data polarity<br><br>Examples:<br>DP Display the current data polarity<br>DP 0 Set data polarity to NOT inverted (OFF)<br>DP 1 Set data polarity to inverted (ON) | Standard | Y | DP 0 |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| DS | Data Source | Report or set data source state<br>Unit always reverts to DS 0 (external) at power-up<br><br>Examples:<br>DS Display current data source<br>DS 0 Set data source to external<br>DS 1 Set data source to internal (value of internal source is set by ID command) | Standard | N | DS 0 |
| FO | Frequency Offset | Offsets the synthesizer +X MHz and the FPGA -X MHz<br>Example:<br>FO 0.0055 offsets 5.5 kHz | FO | Y | FO 0 |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| FR | Frequency | If no argument is passed, it reports the frequency. If an argument is passed, it sets the frequency. The argument specifies the frequency in MHz. If the command is entered with a '?', then the allowed frequency ranges for this unit display.<br><br>This command rounds the frequency to the nearest 0.5 MHz. If the rounded frequency is within one of the transmitter's allowed bands, the transmitter will tune that frequency and confirm the change for the user.<br><br>If the frequency is outside of the allowed range for the unit, the transmitter will NOT retune but will report an error to the user.<br><br>Examples:<br>FR Display the current frequency<br>FR ? Display allowed frequency ranges<br>FR 1436.5 Set frequency to 1436.5 MHz | Standard | Y | FR 1436.5 |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| FS | Frequency Step | If no argument is passed, it reports the current frequency step. If an argument is passed, it sets the frequency step size, which is activated by the left and right square bracket keys. The argument specifies the frequency step in MHz, with 0.5 MHz being the smallest available step.<br>Examples:<br>FS Display the current frequency step<br>FS 1 Frequency step = 1 MHz | Standard | Y | FS 1 |
| H (or HE) | Help | Displays a list of available commands<br>Commands require a carriage return at the end of the line and may also accept parameters<br>Some commands may not be enabled depending on required options | Standard | N/A | N/A |
| HP | High Power | Report or set high power level<br>Valid range is 0 to 31<br><br>Examples:<br>HP Report the present high power level<br>HP 31 Set high power to 31<br>HP Max Set high power to the highest allowable value for the unit<br>HP Min Set high power to the minimum allowable value for the unit | DP | Y | HP 31 |
| HX | eXtended Help | Displays a full list of available commands | Standard | N/A | N/A |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| IC | Internal Clock Rate | Report or set the internal clock rate<br>This rate is used if the clock source is set to internal (CS 1) and the data source is set to internal (DS 1). It should not be confused with "BR", which sets the rate of the internal bit sync, which phase locks to the externally applied data.<br><br>If no argument is passed, the unit reports the clock frequency. If a valid frequency is given, the internal clock frequency is set. The frequency is in Mbps.<br><br>Examples:<br>IC Display current internal clock rate<br>IC 4.95 Set internal clock rate to 4.95 MHz<br><br>Valid range is 0.002 MHz – 28.0 MHz<br>Observes same bit rate limits as HR/LR commands (PCM/FM half) | Standard | Y | IC 5 |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| ID | Internal Data Gen | Report or set the internal data pattern<br>This setting is used if the Data Source is set to internal (DS 1) and the Clock Source is set to internal (CS 1).<br><br>When setting the data, the argument must be “PN6” (or “PN06”), “PN11”, “PN15”, or “PN23”, or a valid 4 digit hexadecimal value.<br><br>Examples:<br>ID Report the internal data pattern<br>ID PN15 Set internal data pattern to PN15<br>ID AA55 Set internal data pattern to 0xAA55<br><br>In SOQPSK mode, ID 5555 or ID AAAA will result in an unmodulated carrier, at the nominal carrier frequency.<br><br>**Note:** If the CP07 option is present, the input argument does not include the “PN” and a hexadecimal value requires the addition of a leading “x”, as shown in the following example.<br>CP07 Examples:<br>ID Report the internal data pattern<br>ID 15 Set internal data pattern to PN15<br>ID xAA55 Set internal data pattern to 0xAA55 | Standard | Y | ID PN15 |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| IS | Input Source Selection | Selects the clock and data source (and user pattern and clock rate, where applicable) using a single command<br><br>IS PN15 4.5 Sets unit to internal clock/data with a PN15 pattern at 4.5Mbps<br>IS AT AUTO Sets unit to use the auxiliary TTL input in clock free mode with auto bit rate enabled<br>IS EN 10 Sets unit to use the Ethernet interface for both clock and data and to set the desired bit rate to 10 Mbps<br><br>Refer to section 4.2.1.1.1 for additional IS command detail | Standard on all T3 units version 2.409 or greater | N/A | N/A |
| LC | List Configurations | Lists the stored configurations on the unit<br>If a configuration number is supplied, then the saved parameters for that configuration are displayed.<br><br>Examples:<br>LC List all internal saved configurations<br>LC 7 Show configuration 7 details | Standard | N/A | N/A |
| LD | LDPC Encoding Enable | Enable, disable, or show the current state of the Forward Error Correction (FEC) / Low Density Parity Check (LDPC) encoder<br><br>Examples:<br>LD Show the current encoder state<br>LD 1 Enable the LDPC encoder<br>LD 0 Disable the LDPC encoder | LDPC | Y | LD 0 |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| LP | Low Power | Report or set low power level<br>Valid range is 0 to 31<br><br>Examples:<br>LP Report the present low power level<br>LP 3 Set low power to 3<br>LP Max Set low power to the highest allowable value for the unit<br>LP Min Set low power to the minimum allowable value for the unit | DP | Y | LP 0 |
| MA | Modes Allowed | Reports the modes enabled on the transmitter, as determined by the part number | Standard | N/A | N/A |
| MJ | Modulation Scaling Step Size | Sets the current modulation scaling factor used when the single key Power Step Up and Power Step Down functions are used<br>Valid range is .0009 to 10.01 | MS | Y | MJ 1.5 |
| MO | Modulation | Report or set modulation setting<br>Mode 6, Carrier only, is present on every transmitter<br><br>Examples:<br>MO Report the modulation setting<br>MO 0 Set modulation to PCM/FM<br>MO 1 Set modulation to SOQPSK-TG<br>MO 2 Set modulation to MULTI-h CPM<br>MO 6 Carrier only, no modulation | Standard | Y | MO 0 or the first one the customer has installed on the unit<br>Example:<br>MO 1 if no PCM/FM installed;<br>MO 2 if only CPM installed |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| MS | Modulation Scaling | Scales the deviation (modulation index) of the transmitted signal relative to the standard default deviation<br>Example:<br>For PCM/FM – if the standard modulation index is 0.7, setting MS to 2.0 scales a modulation index of 1.4<br>Value range is .09 to 10.01 | MS | Y | MS 1 |
| OC | Overtemperature Control | Enable Enables or disables overtemperature control<br>OC 0 Disable Overtemperature Control<br>OC 1 Enable Overtemperature Control<br>If the transmitter temperature goes above the set limit stored on the device and the current power level is over 25, the transmitter automatically starts to back off power in 2 dB steps to a maximum of 6 dB. | Standard | Y | OC 1 |
| PR or RE | Restore Defaults | Restores factory default parameters for the unit<br>Default is currently the lowest number modulation supported by the transmitter with the selected band and frequency limits<br>Default power level is Full power | Standard | N/A | N/A |
| QA | Query All | Displays common device settings in one compact display<br>Display is a subset of SS or ST | Standard | N/A | N/A |
| QT or TE | Query Temperature | Report the temperature in degrees Celsius | Standard | N/A | N/A |
| RA or RN | Randomizer | Report or set IRIG-106 randomizer output state<br>Examples:<br>RA Report the randomizer state<br>RA 0 Set randomizer OFF<br>RA 1 Set randomizer ON | Standard | Y | RA 0 |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| RC<br>(or PP or RL) | Recall Configuration | Load a saved configuration into the active configuration if the configuration number entered is valid<br>If the selected configuration has no valid data or the command is issued without a configuration number, the transmitter is initialized with the default data and saved.<br><br>Example:<br>RC Load configuration 0 (default setup)<br>RC 3 Load configuration 3 | Standard | N/A | N/A |
| RF | RF Output | Report or set RF output control state<br>Note that there may be no RF output, even if the software control is set to ON. This can happen if there is no valid clock in use, or if the RF on/off hardware pin is in the OFF state.<br><br>Examples:<br>RF Report the RF output state<br>RF 0 Set RF output OFF<br>RF 1 Set RF output ON | Standard | Y | RF 1<br>(if option CP07, default is RF 0) |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| RZ | RF On/Off Pin Polarity | Set or show the polarity of the RF on/off pin, which is pulled high internally to 3.3 VDC<br>RZ 0 means the RF is ON when the RF on/off pin is low<br>RZ 1 means the RF is ON when the RF on/off pin is high (floating)<br><br>Examples:<br>RZ Show the current RF on/off polarity<br>RZ 0 Set RF on/off polarity to "pin low = on"<br>RZ 1 Set RF on/off polarity to "pin high = on" | Standard | Y | RZ 1 |
| SB | Cycles per Bit | Report or set cycles per bit<br>(The subcarrier frequency is cycles per bit times bit rate.)<br>SB Report cycles per bit<br>SB x Set cycles per bit | STDN | Y | SB 0 |
| SM | Modulation Sweep | Sweeps the transmitter modulation between the provided limits with the provided step size at a fixed rate<br><br>Examples:<br>SM Toggle sweep ON/OFF with current values<br>SM ? Displays current sweep state<br>SM start stop step msec<br>start = low index<br>stop = high index<br>step = index step size<br>msec = milliseconds between steps | MS | N | SM Disabled |
| SN | Serial/Part Number | Report the serial number and part number for the unit | Standard | N/A | N/A |
| SS | Show Settings | Displays most of the common device settings in one compact display | Standard | N/A | N/A |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| SV or SA (or PS or PW) | Save Configuration | Saves the current transmitter configuration to a user-selected preset number, from 0 to 15 where 0 is the power-on default unless hardware presets are enabled<br>The SV command also allows the user to assign an alias to the desired preset.<br><br>Examples:<br>SV 1 Save current configuration to preset 1<br>SV 7 xyz Save current configuration to preset 7 and assign alias name "xyz"<br>***Refer to SV Note below for exception** | Standard | N/A | N/A |
| SY | System Status | Displays the system status of the transmitter<br>The first argument specifies the period, in seconds, between status updates. Zero (0) disables continuous monitoring.<br>The second argument specifies the number of status lines between header outputs.<br>Examples:<br>SY Displays current status report settings<br>SY 5 Sets status output period to 5 seconds<br>SY 5 100 Sets status header output once every 100 status updates<br>Refer to section 4.2.1.1.2 for additional SY command detail | Standard | N/A | N/A |
| VE or RV | Version (Revision Information) | Report the current Firmware (software) version information for the transmitter | Standard | N/A | N/A |

| Mnemonic Command | Name | Description | Option (s) Required | Setting Saved? | Factory Default |
|---|---|---|---|---|---|
| VF | Variable FIFO Depth | Sets the FIFO depth for controlling latency time between bits in and bits out<br>Valid range is 0 to 255<br>Example: VF 120 (120 = Variable Power) | VF | Y | VF 128 |
| VP | Variable Power | Report or set variable power level<br>Valid range is 0-31<br>Examples:<br>VP Report the variable power level<br>VP 31 Set variable power to 31<br>VP 5 Set variable power to 5<br>VP Max Set variable power to the highest allowable value for the unit<br>VP Min Set variable power to the minimum allowable value for the unit | VP | Y | VP 0 |
| ZX | Show Preset Inputs | Displays the current preset inputs on the parallel connector<br>Available presets depend on the number specified for the unit<br>Values are PS2, PS4, PS8, or PS16 | Standard | N/A | N/A |
| ZZ | Show Options | Displays the current hardware configuration and options on the transmitter | Standard | N/A | N/A |

All commands generate a response of one or more lines, which indicate successful completion of the command or an error.

After a command's response, the transmitter displays the mode name followed by the character ">" as a prompt, which may be interpreted as meaning the radio is ready to accept new characters. If the CP07 option is enabled, only the character ">" displays as a prompt.

***SV Note:** Users may save internal clock and data in presets for bench debug use BUT on a power up or when a *hardware* preset is restored, **CS** and **DS** will be forced to **0** (external clock and data). This action prevents a transmitter from powering up or changing hardware presets and being set to internal clock and/or data. The ONLY way to restore CS and/or **DS** as **1** from a saved configuration is by executing the **RC** command.

#### 4.2.1.1 Additional Command Set Details

##### 4.2.1.1.1 Input Source Selection Command - IS

The IS command is used to select the clock and data source (and the user pattern and clock rate where applicable) for the transmitter with one command. This command can conceivably replace CS, DS, ID, IC, BR, BT, AIR, CF, and EN. *This command is standard on all T3 units version 2.409 or greater.*

Syntax: IS [ds/?/pnxx/XXXX [cs/AUTO/rate]]

where **ds** is data source which can be:

| | |
|---|---|
| ET - external TTL data | (if QSX-VxT or -VR enabled) |
| ER - external RS422 data | (if QSX-VxR or -VR enabled) |
| EL - external LVDS data | (if QSX-VxL or -VR enabled) |
| I - internal with currently selected data pattern | |
| PNxx - internal with specified PN sequence | |
| XXXX - internal with specified fixed 4 digit hex pattern | |
| AB - auxilliary input bipolar data | (if -CF and -AI enabled) |
| AT - auxilliary input TTL data | (if -CF and -AI enabled) |
| EN - Ethernet | (if -EN enabled) |

If ds = ET, then cs MAY be:

- Nothing (defaults to ET for an external ttl clock)
- ET for an external TTL clock

  *Actions:* ds 0, cs 0, bt 1 (if needed), cf 1 (if needed)
- X for clock free with current BR (if -CF enabled)

  *Actions:* ds 0, cs 0, (bt 1 if needed), cf 0
- AUTO for clock free with BR = auto

  *Actions:* ds 0, cs 0, cf 0, br a (bt 1, ai 0, and en 0 if needed)
- XX.xxx for clock free with BR = XX.xxx

  *Actions:* ds 0, cs 0, cf 0, br XX.xxx (bt 1, ai 0, and en 0 if needed)

If ds = ER or EL, then cs MAY be:

- Nothing (defaults to ER for an external RS422 clock)
- ER for an external RS422 clock
- EL for an external LVDS clock

  *Actions*: ds 0, cs 0, bt 3 (if needed), cf 1 (if needed)
- X for clock free with current BR (if -CF enabled)

  *Actions*: ds 0, cs 0, (bt 3 if needed), cf 0

- AUTO for clock free with BR = auto

  *Actions*: ds 0, cs 0, cf 0, br a (bt 3, ai 0, and en 0 if needed)
- XX.xxx for clock free with BR = XX.xxx

  *Actions*: ds 0, cs 0, cf 0, br XX.xxx (bt 3, ai 0, and en 0 if needed)

If ds = I, then cs MAY be:

- Nothing (defaults to internal clock at current IC rate) (displayed)
- I for an internal clock at current IC rate (displayed)

  *Actions*: ds 1, cs 1, ic
- XX.xxx for internal clock with ic = XX.xxx

  *Actions*: ds 1, cs 1, ic XX.xxx

If ds = PNxx, then cs MAY be:

- Nothing (defaults to internal clock at current IC rate) (displayed)
- I for an internal clock at current IC rate (displayed)

  *Actions*: ds 1, cs 1, id pnxx, ic
- XX.xxx for internal clock with ic = XX.xxx

  *Actions*: ds 1, cs 1, id pnxx, ic XX.xxx

If ds = XXXX, then cs MAY be:

- Nothing (defaults to internal clock at current IC rate) (displayed)
- I for an internal clock at current IC rate (displayed)

  *Actions*: ds 1, cs 1, id XXXX, ic
- XX.xxx for internal clock with ic = XX.xxx

  *Actions*: ds 1, cs 1, id XXXX, ic XX.xxx

If ds = AB, then cs MAY be:

- Nothing (defaults to clock free at current BR) (displayed)

  *Actions*: ds 0, cs 0, ai 1, cf 0 AIR 0 br (en 0 if needed)
- X for clock free with current BR

  *Actions*: ds 0, cs 0, ai 1, cf 0 AIR 0 br (en 0 if needed)
- AUTO for clock free with BR = auto

  *Actions*: ds 0, cs 0, ai 1, cf 0 AIR 0 br a (en 0 if needed)
- XX.xxx for clock free with BR = XX.xxx

*Actions*: ds 0, cs 0, ai 1, cf 0 AIR 0 br XX.xxx (en 0 if needed)

If ds = AT, then cs MAY be:

- Nothing (defaults to clock free at current BR) (displayed)

  *Actions*: ds 0, cs 0, ai 1, cf 0 AIR 1 br (en 0 if needed)
- X for clock free with current BR

  *Actions*: ds 0, cs 0, ai 1, cf 0 AIR 1 br (en 0 if needed)
- AUTO for clock free with BR = auto

  *Actions*: ds 0, cs 0, ai 1, cf 0 AIR 1 br a (en 0 if needed)
- XX.xxx for clock free with BR = XX.xxx

  *Actions*: ds 0, cs 0, ai 1, cf 0 AIR 1 br XX.xxx (en 0 if needed)

If ds = EN, then cs MAY be:

- Nothing (defaults to Ethernet clock at current IC rate) (displayed)

  *Actions*: ds 0, cs 0, en 1 (cf 1 if needed) (ai 0 if needed)
- XX.xxx for ethernet clock with ic = XX.xxx

  : ds 0, cs 0, en 1 ic XX.xxx (cf 1 if needed) (ai 0 if needed)

Notes:

Numbers need only as many significant digits as necessary. For example, to specify 10 Mbps (for either BR or IC) you can enter 10, 10.0, 10.000, etc.

Some command versions require the unit to have specific options and will not work without those options. For instance, you cannot specify EN for Ethernet unless the unit has the -EN option in the part number.

While this command incorporates the functionality of nine (9) or more commands, those commands are still usable. For example, if the unit has the -VR option then the BT command can still be used by itself to switch between TTL and RS-422 inputs for clock and data.

Examples:

| | |
|---|---|
| IS ET | Sets unit to 'normal' mode expecting external TTL clock and data to be applied to the unit inputs |
| IS PN15 4.5 | Sets unit to internal clock/data with a PN15 pattern at 4.5Mbps |
| IS AT AUTO | Sets unit to use the auxiliary TTL input in clock free mode with auto bit rate enabled |
| IS EN 10 | Sets unit to use the Ethernet interface for both clock and data and to set the desired bit rate to 10 Mbps |

#### 4.2.1.1.2 System Status Command – SY

The SY command is defined as follows.

| Mode | CF Rate (b/s) | Freq (Hz) | Tmp (C) | CRate (b/s) |
|---|---|---|---|---|
| 0 | 10001252 | 2255000000 | 27.0 | 19999948 |

**Mode** - Current mode number (such as 0 = PCM/FM)

**CF Rate** - Clock free estimated data rate. This rate is based on the external data input (TTL or RS-422) even if internal data is presently in use (CS = 1).

**Freq** - Tuned frequency

**Tmp** - Current temperature

**CRate** - Clock filter clock rate. This is the actual over the air bit rate, regardless of the selected data source, and including any increases due to encoding (LDPC or convolutional). IN clock free automatic mode, it may differ from CF Rate because it will track the bit sync rate (exact, if locked) rather than the clock free estimated rate (approximate).

# 5 RF Output Notes

There are three methods of muting the RF output. If you do not have RF output, check these conditions:

1. RF On / Off command – From the control terminal, type "RF" to query the current state of the RF On / Off variable. If it is 0, type "RF 1" to turn the output back ON.
2. External clock removal – This only applies to non-clock free units. If the unit is configured to use the external clock (CS = 0), that clock's presence is detected. If it is not present, the RF output automatically shuts OFF. When the data clock comes back, the RF output automatically turns ON. The lag from data clock state change to RF output change is about 0.1 seconds.
3. RF On / Off pin – Pin 9 - If this pin is grounded, the RF is turned off. This hardware control overrides the RF On / Off serial command. Check using the RZ command if this is a special unit.

## 5.1 Troubleshooting the RF on a Quasonix Transmitter

The following is a quick, three-part test to verify that the RF output on the transmitter is working correctly. This procedure should work for most transmitters with no modifications, however the sheer number of extra options and variations means that some units will need some special instructions or may work slightly differently. Examples are auto-carrier (-AC option), clock free (-CF option) and recall-holdoff (-RH option). If the procedure below does not demonstrate the working RF output on the transmitter, please contact Quasonix technical support for further help in resolving the issue.

The three sections below demonstrate RF output functionality one step at a time: first a carrier, then a waveform based on internal clock and data, and finally the waveform using the user supplied external clock and data. Part one demonstrates a simple carrier output at the desired frequency. Part two demonstrates proper waveform modulation using internal clock and data generated by the transmitter itself. Part three switches to the user supplied external clock and data for normal operation. If the first two parts work correctly, then the only missing piece is the external clock and data, so resolving any final issues becomes easier.

**Part 1: Checking for carrier power output on frequency**

1. Turn on power to the transmitter.
2. Set the mode to 6 (carrier only) using command **MO 6**.
3. Set transmitter to the desired frequency using the **FR** command. For example, **FR 2200.5**.
   - To see the allowed frequencies on your unit, type **FR ?**.
4. Turn the soft RF control on with **RF 1**.
5. Use a Spectrum Analyzer to determine whether there is a stick at the desired frequency. If there is, go on to Part 2.
6. If there is no output, check the state of the RF On/Off pin.
   - If the pin appears to be in the correct state to enable the output, check the RF On/Off pin polarity using the **RZ** command.
   - If the polarity is incorrect, change it.
     - **RZ 1** sets the transmitter output to turn ON when the RF On/Off pin is high (3.3 VDC).
     - **RZ 0** sets the transmitter output to turn ON when the RF On/Off pin is low.
7. Is the output present now? If so, go on to Part 2 below. If not, call Quasonix for technical support.

**Part 2: Verifying modulation output on frequency with internal data**

1. Turn on the transmitter.
2. Set the mode to one of the available modes on your unit. For example, **MO 0** for PCM/FM, **MO 1** for SOQPSK, etc.
3. Set transmitter to the desired frequency using the **FR** command. For example, **FR 2200.5**.
   - To see the allowed frequencies on your unit, type **FR ?**.
4. Turn the soft RF control ON with **RF 1**.
5. Enable the internal clock source with **CS 1**.
6. Enable the internal data source with **DS 1**.
7. Set the internal clock rate to 5 Mbps with **IC 5**.
8. Set the internal data pattern to PN15 with **ID PN15**.
9. Use a spectrum analyzer to verify the desired waveform on the RF output at the desired frequency.
10. If the waveform is NOT present, check the state of the RF On/Off pin. Use the **RZ** command to check the current polarity of the RF On/Off pin.
    - **RZ 1** sets the transmitter output to turn ON when the RF On/Off pin is high (3.3 VDC).
    - **RZ 0** sets the transmitter output to turn ON when the RF On/Off pin is low.
11. Change either the RF On/Off pin or the polarity to turn the RF output ON.
12. Check for the RF output on the spectrum analyzer.
    - Is the output present now? If so, go on to Part 3.
    - If not, call Quasonix for technical support.

**Part 3: Verifying modulation output on frequency with user data**

1. Turn on the transmitter.
2. Set the mode to one of the available modes on your unit. For example, **MO 0** for PCM/FM, **MO 1** for SOQPSK, etc.
3. Set transmitter to the desired frequency using the **FR** command. For example, **FR 2200.5**.
   - To see the allowed frequencies on your unit, type **FR ?**.
4. Turn the soft RF control on using **RF 1**.
5. Disable the internal clock source with **CS 0**. This is the normal state on power up for most units.
6. Disable the internal data source with **DS 0**. This is the normal state on power up for most units.
7. Be sure that a clock source is connected to the correct pins of the transmitter input connector with the correct type (TTL or RS-422) of signal and in the case of RS-422, the correct polarity.
8. Be sure that the clock source is ON and that the clock rate is within the allowed range for the mode selected. Typically this is 100 kbps to 28 Mbps for Tier 1 and 2 waveforms and 50 kbps to 14 Mbps for Tier 0.

9. Be sure that a data source is connected to the correct pins, with the correct type (TTL or RS-422) and polarity as above.
10. Use a spectrum analyzer to verify the desired waveform on the RF output at the desired frequency.
11. If the waveform is NOT present, check the state of the RF On/Off pin. Use the **RZ** command to check the current polarity of the RF On/Off pin.
    - **RZ 1** sets the transmitter output to turn ON when the RF On/Off pin is high (3.3 VDC).
    - **RZ 0** sets the transmitter output to turn ON when the RF On/Off pin is low.
12. Change either the RF On/Off pin or the polarity to turn the RF output ON.

You may issue the RF command and observe the status which is returned. This status indicates whether the transmitter believes the RF output is actually ON or not.

The **SY** command may be issued to check the actual clock rate that the transmitter sees if no RF output is detected. One of the most common problems is a clock rate that is too high or too low (or missing) for the desired modulation.

Finally, if you have a full RF loop running with a BERT and are having trouble achieving a zero bit error rate or lock, try the loop using internal data with the standard PN15 bit pattern. Be sure the BERT pattern is set to match the selected data pattern (**ID** command) on the transmitter. Assuming the internal data syncs and produces a zero bit error rate, you can switch back to the external clock and data. In this case, you can also check (and change) the clock polarity (**CP**) the data polarity (**DP**), the randomizer (**RA**), and the differential encoder (**DE** - normally on for SOQPSK and off for other waveforms) to resolve the sync and bit error rate issues.

If you are still having difficulties at this point, then contact Quasonix technical support.

**Quasonix Technical Support**
**(1-513-942-1287) or email (support@quasonix.com)**

When calling technical support, it will speed things up if you have the following information handy:

- Model number (obtained with the **ZZ** command) ***Note that this is different from the customer part number.***
- Serial number (obtained with the **SN** command)
- Software Version (obtained with the **VE** command)

It is also helpful if you can call from a phone in your lab so our tech support people can actually walk you through setting, checking, and controlling your transmitter).

# 6 Performance Specifications

## 6.1 RF Output

The minimum RF output power is one of the following: 10 mW, 1 W, 2 W, 5 W, or 10 W with the RF load VSWR < 2:1 at all phase angles from 0 to 360 degrees.

## 6.2 Electrical Current

The electrical current drain for nanoTX™ transmitters is provided in Table 17.

**Table 17: DC Input Current at Standard Input Voltage**

| Band Type | Wattage | Maximum Amps | Typical Amps @ 28 VDC |
|---|---|---|---|
| Single | 10 mW | 300 mA | 250 mA |
| Single | 1 W | 450 mA | 350 mA |
| Single | 2 W | 570 mA | 480 mA |
| Single | 5 W | 1.0 A | 0.8 A |
| Single | 10 W | 1.3 A | 1.1 A |

## 6.3 Environmental Specifications

The nanoTX™ meets the following environmental requirements.

**Table 18: nanoTX™ Environmental Specifications**

| Environmental Specifications | Description |
|---|---|
| Operating temperature (10 mW, 5 W, 10 W models) | -40°C to +85°C |
| Non-operating temperature (all models) | -55°C to +100°C |
| Operating humidity | 0 to 95% (non-condensing) |
| Altitude | Up to 100,000 ft. |

## 6.4 Carrier Frequency Tuning

The carrier frequency is selectable in 0.5 MHz steps. Frequencies supported by the nanoTX™ are listed in Table 19.

**Table 19: Carrier Frequencies (MHz)**

| Band | Minimum Freq | Maximum Freq | Default Freq |
|---|---|---|---|
| Lower L | 1435.5 | 1534.5 | 1450.5 |
| Upper L | 1750.0 | 1855.0 | 1800.5 |
| Lower S | 2200.5 | 2300.5 | 2250.5 |
| S | 2200.5 | 2394.5 | 2370.5 |

## 6.5 Carrier Frequency Error

The frequency error is less than ±20 ppm over all combinations of temperature, voltage, and aging (up to five years).

## 6.6 Bit Error Rate

The transmitter meets the following BER limits when tested with the Quasonix' multi-mode, multi-symbol trellis demodulator.

**Table 20: Transmitter BER Specifications**

| BER | Maximum Eb/N0 (dB) | | |
|---|---|---|---|
| | PCM/FM, Tier 0 | SOQPSK-TG, Tier I | Multi-h CPM, Tier II |
| 10-3 | 7.5 | 9.5 | 11.0 |
| 10-4 | 9.0 | 11.5 | 12.5 |
| 10-5 | 10.0 | 13.0 | 13.5 |
| 10-6 | 11.0 | 14.5 | 14.5 |

## 6.7 Modulated RF Power Spectrum

The transmitter's modulated spectrum complies with the IRIG-106 PSD mask:

$$\mathbf{M\ (dBc) = Max\ (\ \{K - 100\ log\ |f - f_c|\ + 90\ log\ (R)\},\ \{-(55 + 10\ log\ (P))\}\ ),\ |f - f_c|\ \geq R/m\ where}$$

M = power relative to unmodulated carrier (i.e., units of dBc) at frequency f (MHz)

f = frequency in MHz

$f_c$ = the carrier frequency in MHz

R = the bit rate in Mb/s

P = the rated power output of the UUT, in Watts

and the values of K and m are as tabulated in Table 21.

**Table 21: K and m Values per Waveform**

| | K | m |
|---|---|---|
| PCM/FM, Tier 0 | -28 | 2 |
| SOQPSK TG, Tier I | -61 | 4 |
| Multi-h CPM, Tier II | -73 | 4 |

As noted in the equation above, the mask has a floor at –(55 + 10 log(P)) dBc, and the mask imposes no limit on the spectrum for frequency offsets less than R/m. Representative examples of the transmitted spectrum, with the appropriate mask, are shown in Figure 20, Figure 21, and Figure 22.

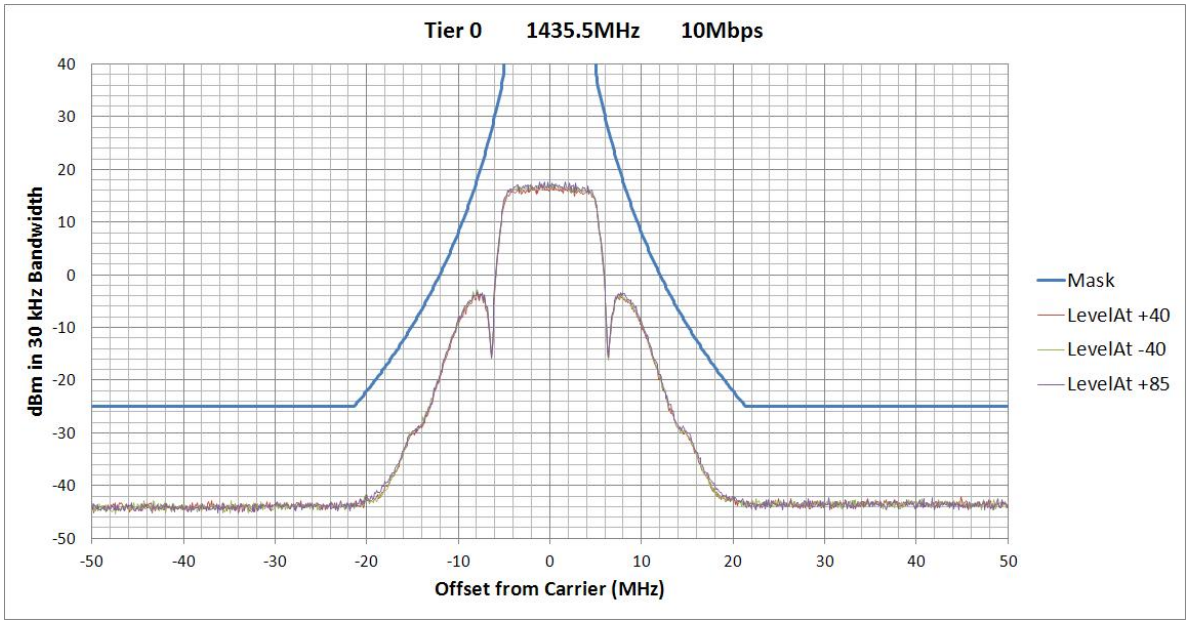



**Figure 20: PCM/FM (Tier 0) PSD and Mask**

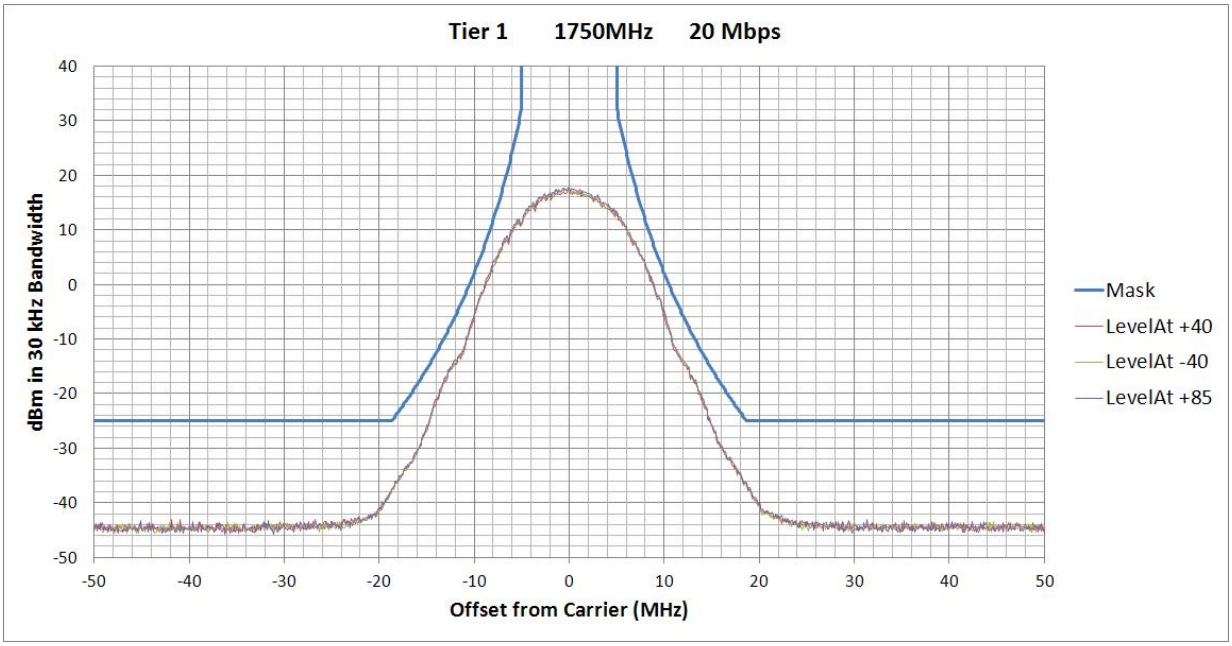



**Figure 21: SOQPSK-TG (Tier I) PSD and Mask**

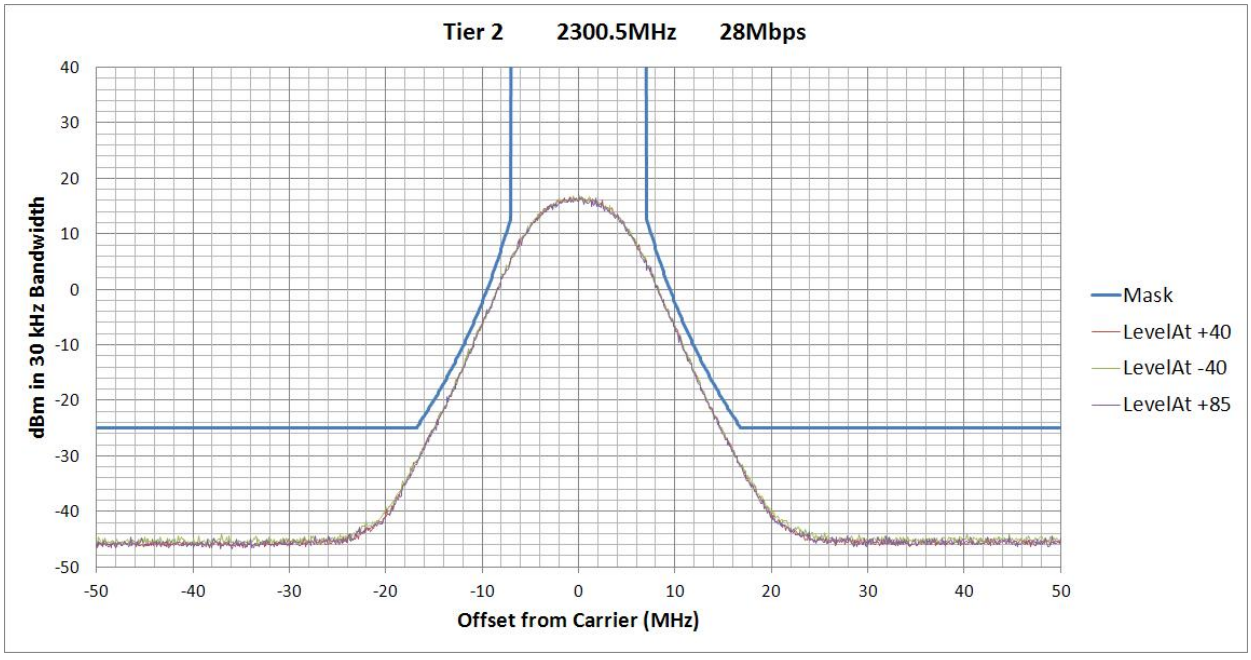



**Figure 22: Multi-h CPM (Tier II) PSD and Mask**

## 6.8 Phase Noise Power Spectrum

TIMTER™ phase noise limits are shown in Figure 23.

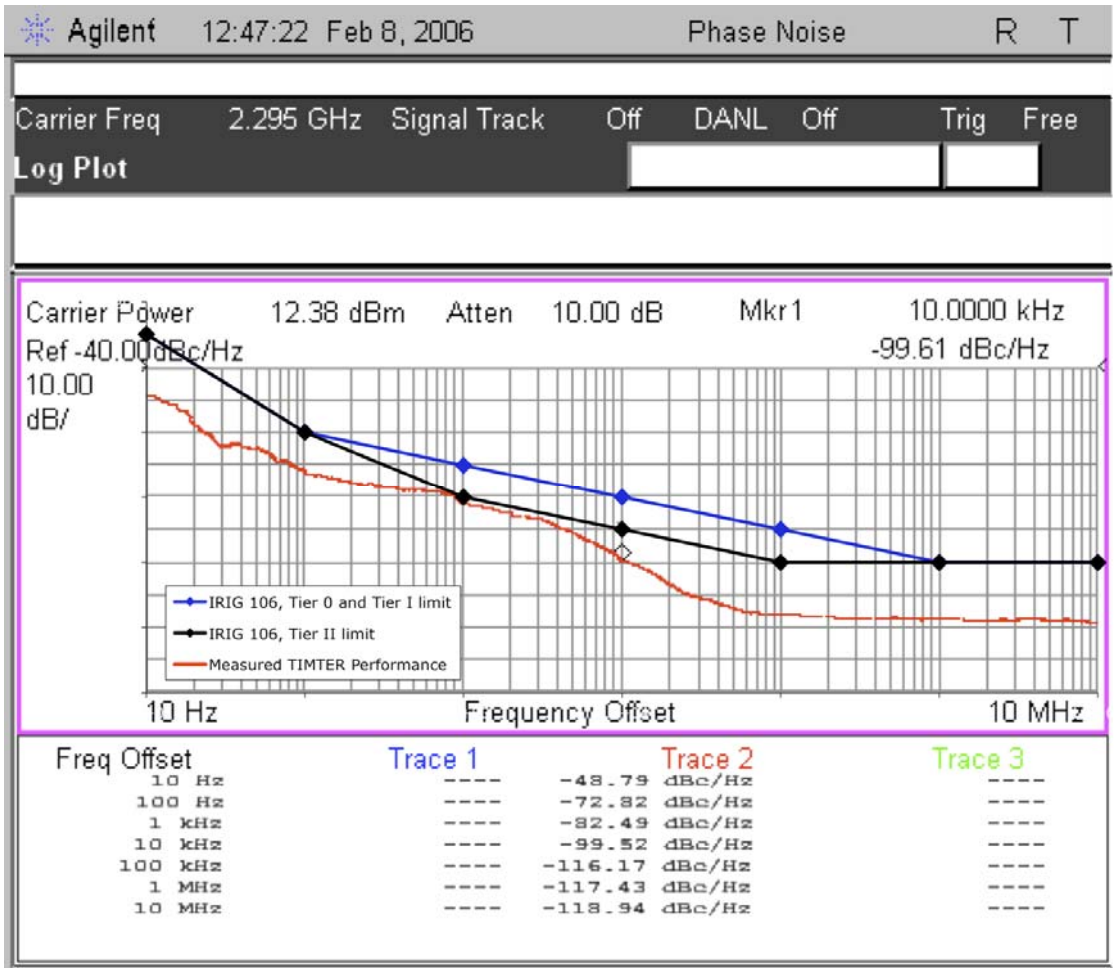



**Figure 23: Phase Noise Limit Curve**

## 6.9 Baseplate Temperature

The nanoTX™ is designed for efficient heat transfer between internal heat producing sources and the baseplate. The 10 mW, 1 W, 2 W, 5 W, and 10 W nanoTX™ and the 10 W nanoPuck™ models are rated for operation with baseplate temperatures ranging from -40°C to +85 °C.

## 6.10 Vibration and Shock

The transmitter is designed and tested to operate normally when subjected to random vibration and shock. The shock and vibe test setup employed by Quasonix is shown in the following figures.

**Figure 24: Vibration / Shock Testing System**

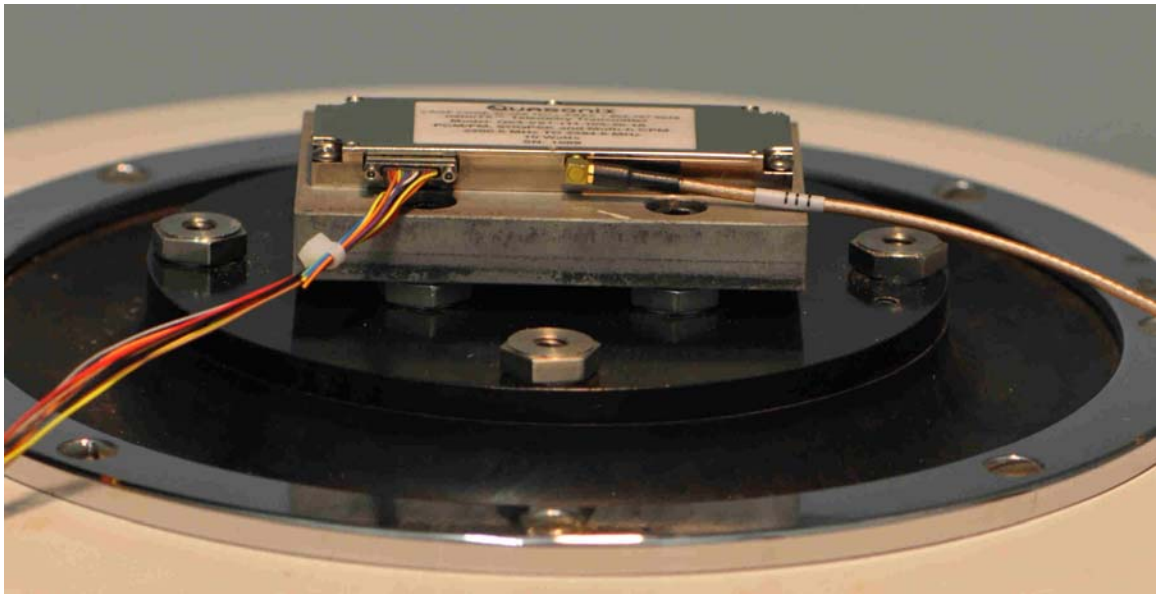


**Figure 25: nanoTX™ Mounted for Z-axis Testing**

Figure 26: nanoTX™ Mounted for X-axis Testing

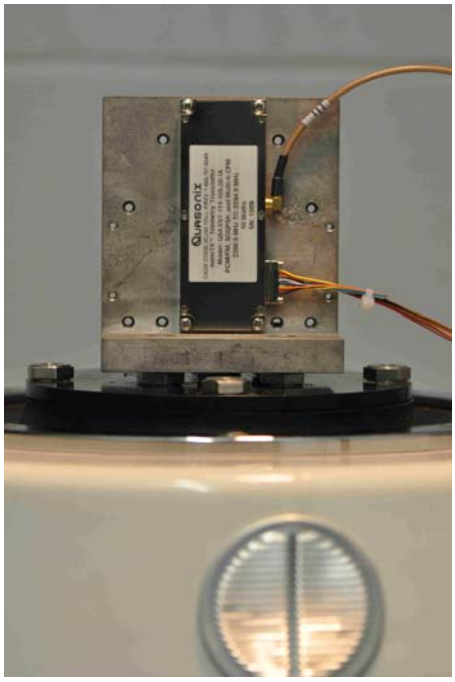


Figure 27: nanoTX™ Mounted for Y-axis Testing

### 6.10.1 Vibration Testing

Each transmitter is subjected to the random vibration spectrum depicted in Figure 28 and Table 22 prior to shipment.

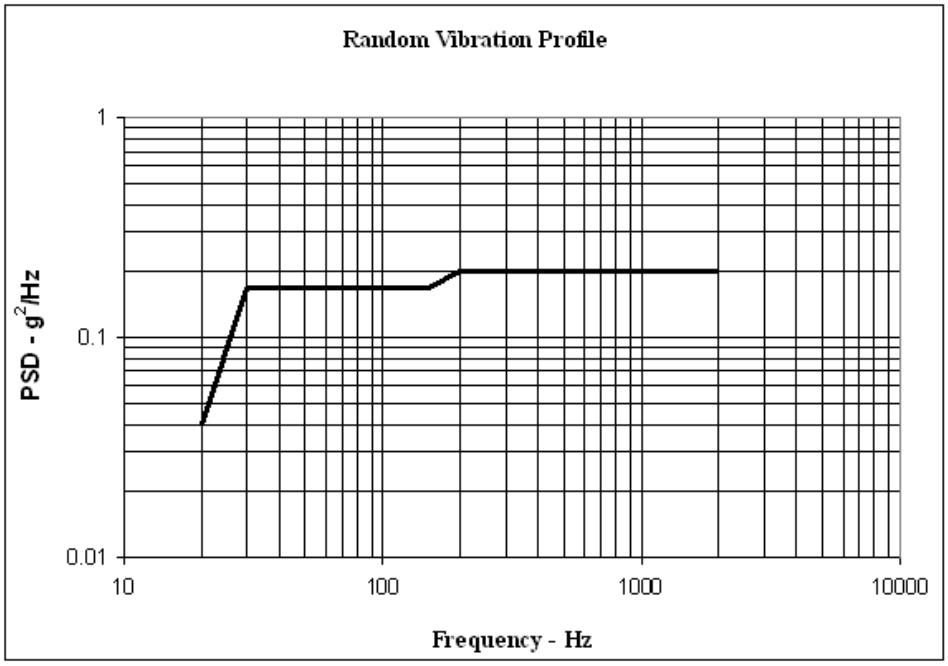



**Figure 28: TIMTER™ Vibration Profile**

**Table 22: Random Vibration Spectrum**

| Breakpoints | |
|---|---|
| **Frequency (Hz)** | **PSD (g2/Hz)** |
| 20 | 0.04 |
| 30 | 0.17 |
| 150 | 0.17 |
| 200 | 0.2 |
| 2000 | 0.2 |
| G (RMS) = 19.6 | |

During flight-qualification testing, the unit under test (UUT) was shaken for 30 minutes in each axis. Results are shown in Figure 29, Figure 30, and Figure 31.

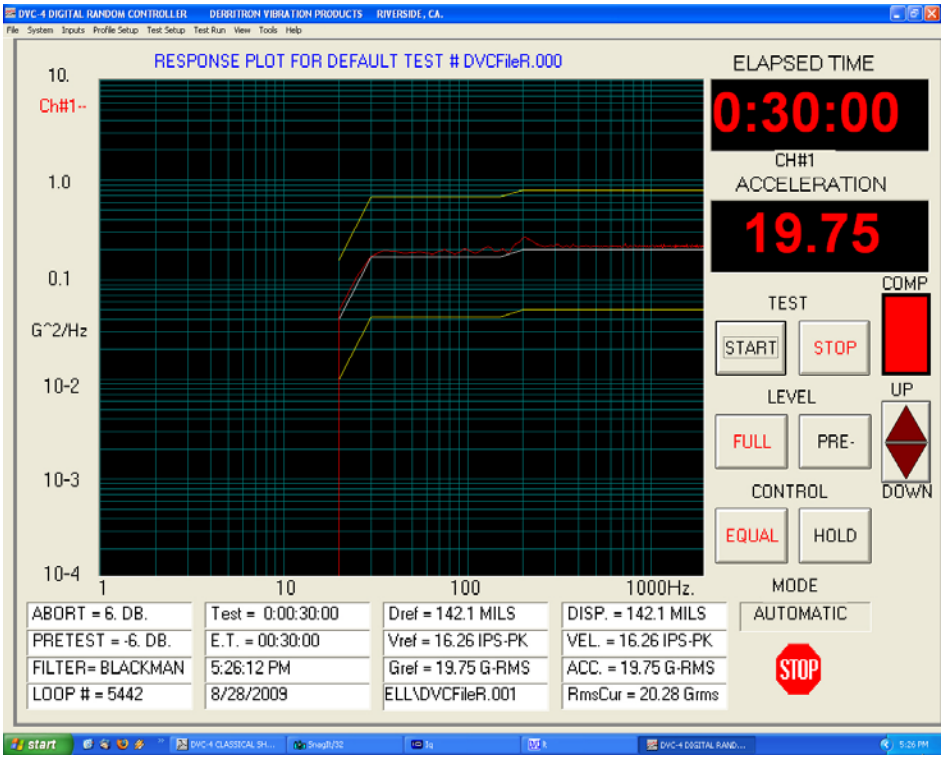



**Figure 29: Z-axis Vibration Spectrum**

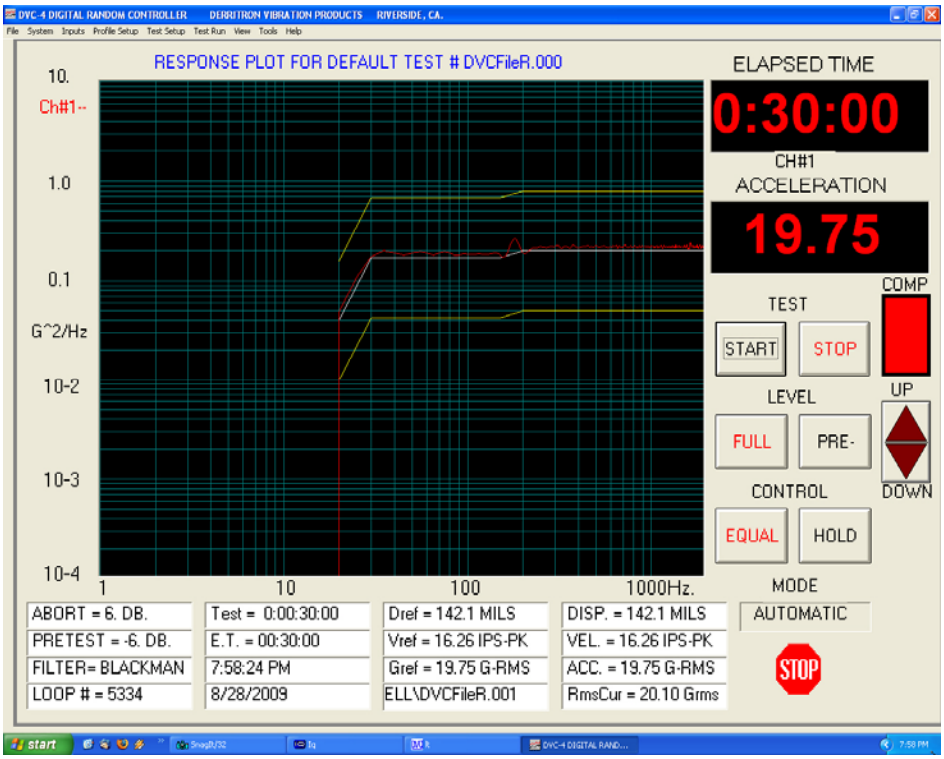



**Figure 30: Y-axis Vibration Spectrum**

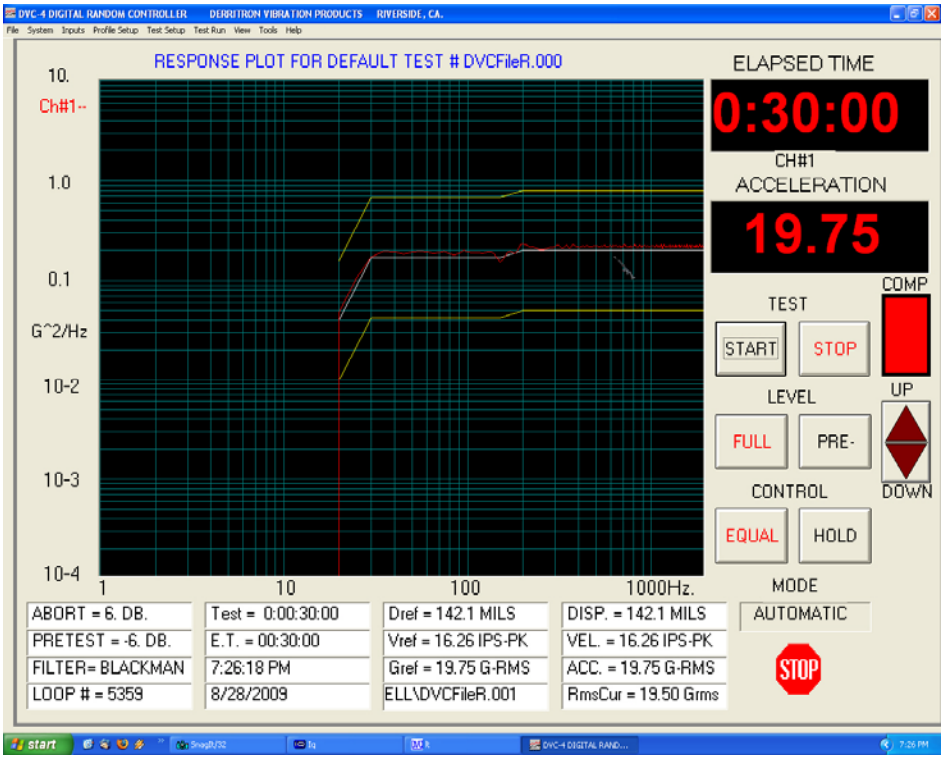



**Figure 31: X-axis Vibration Spectrum**

### 6.10.2 Shock Testing

In addition to vibration testing, the UUT was subjected to shock pulses, as follows:

- Type: Half-sine
- Level: 60 g
- Duration: 5 milliseconds

Application: Three (3) shocks in each direction of the three (3) orthogonal axes both positive and negative, for 18 shocks total

The plots of the positive and negative pulses in each of the three axes are shown in the following figures:

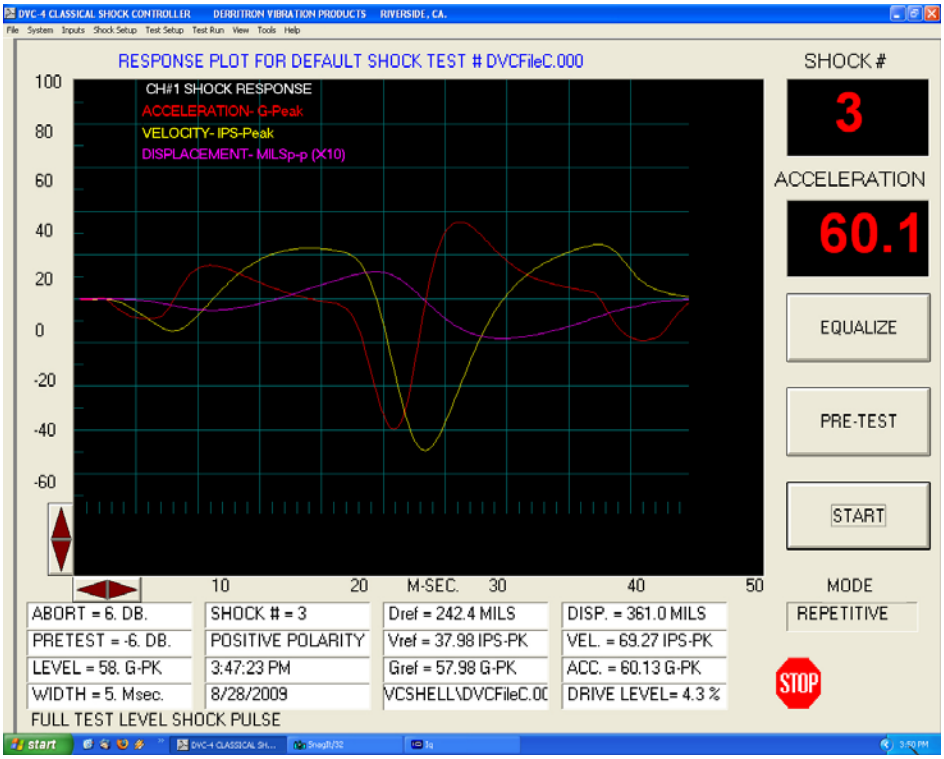



**Figure 32: Shock Pulse, Z-axis Positive**

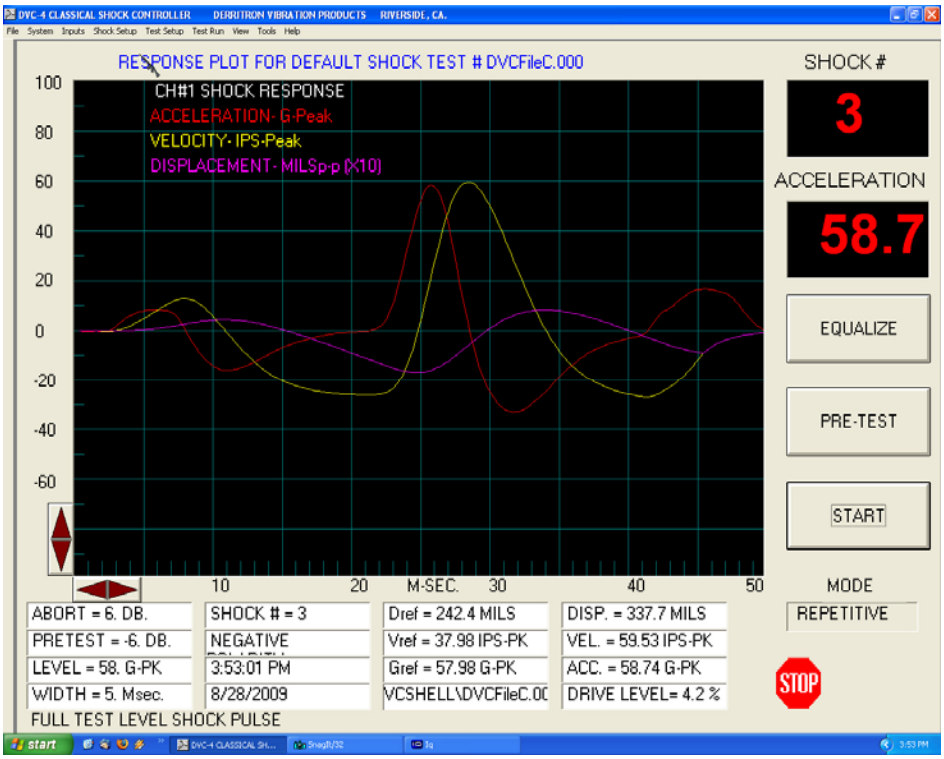



**Figure 33: Shock Pulse, Z-axis Negative**

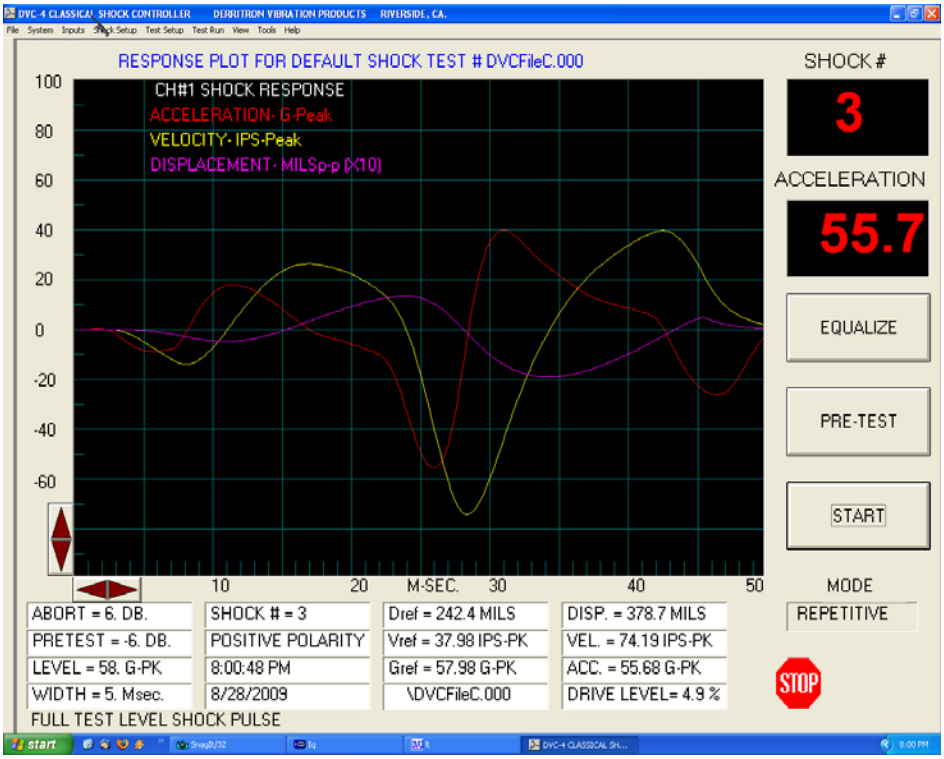



**Figure 34: Shock Pulse, Y-axis Positive**

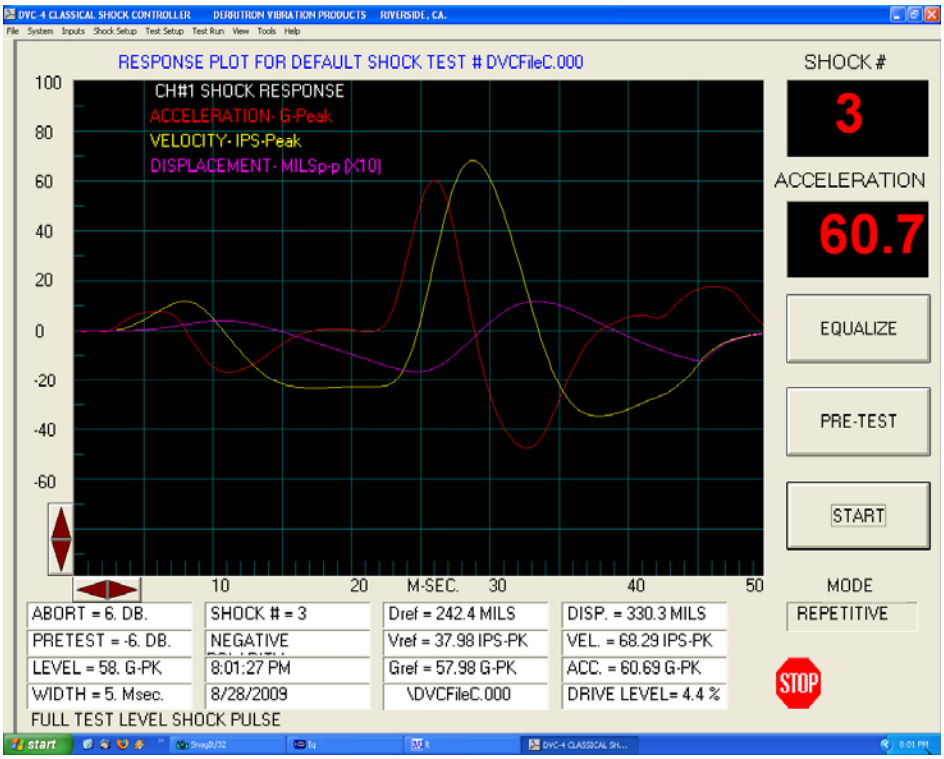



**Figure 35: Shock Pulse, Y-axis Negative**

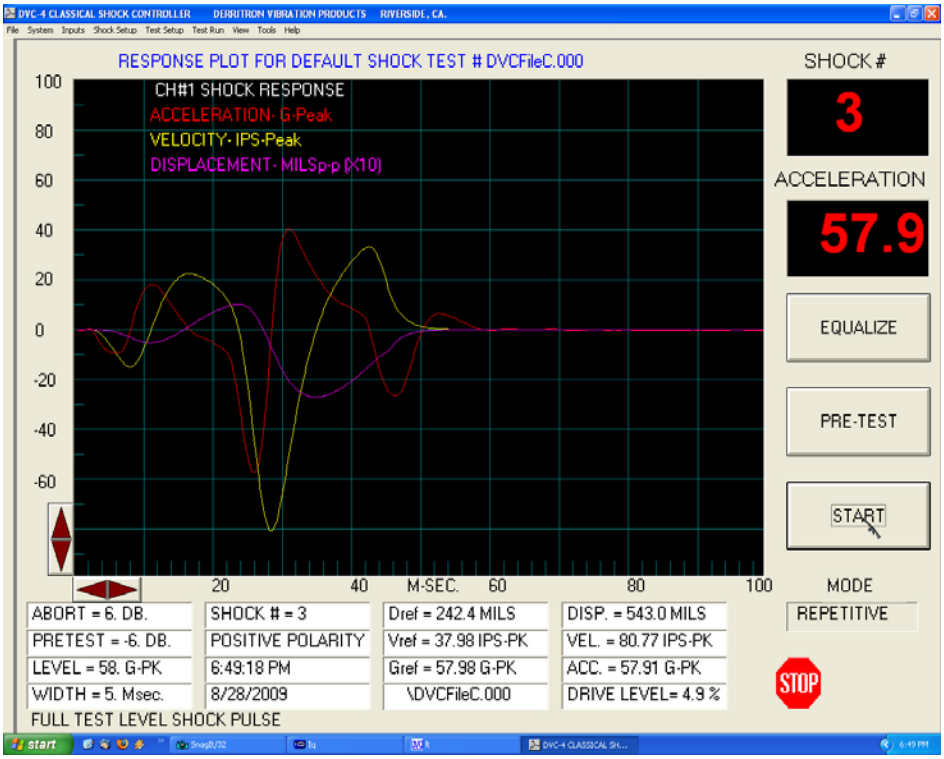



**Figure 36: Shock Pulse, X-axis Positive**

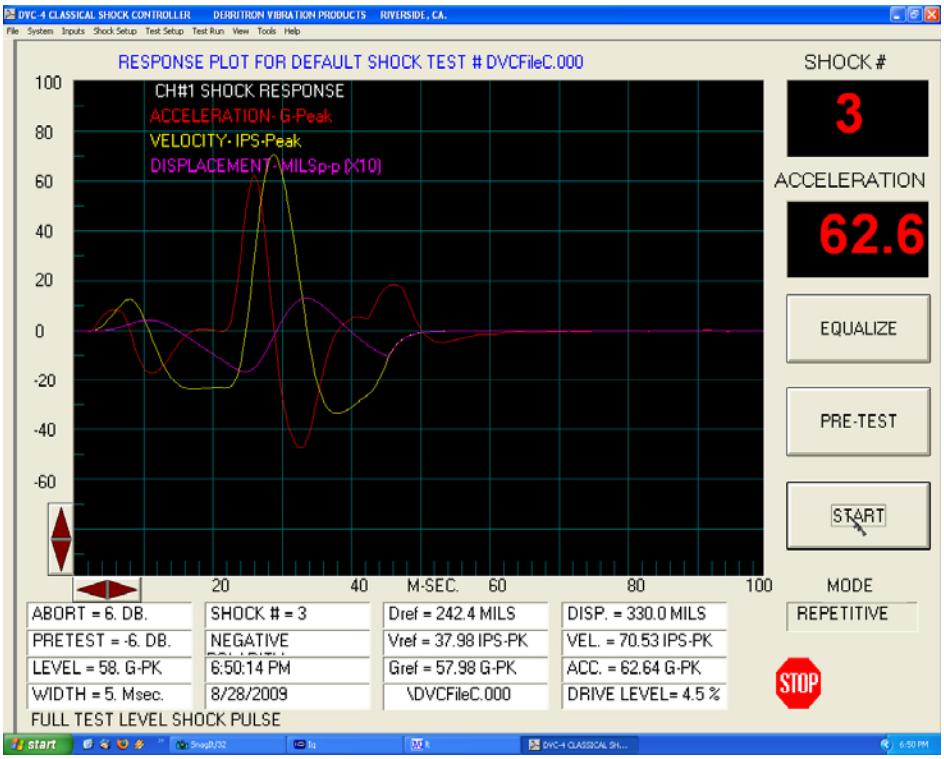



**Figure 37: Shock Pulse, X-axis Negative**

# 7 Maintenance Instructions

The nanoTX™ Telemetry Transmitter requires no regular maintenance, and there are no user-serviceable parts inside.

# 8 Product Warranty

The nanoTX™ transmitter carries a standard parts and labor warranty of one (1) year from the date of delivery.

# 9 Technical Support and RMA Requests

In the event of a product issue, customers should contact Quasonix via phone (1-513-942-1287) or e-mail (support@quasonix.com) to seek technical support. If the Quasonix representative determines that the product issue must be addressed at Quasonix, a returned materials authorization (RMA) number will be provided for return shipment.

Authorized return shipments must be addressed in the following manner:

**Quasonix, Inc.**
**ATTN: Repair, RMA #**
**6025 Schumacher Park Drive**
**West Chester, OH 45069**

**To ensure that your shipment is processed most efficiently, please include the following information with your product return:**

- Ship To – Company name, address, zip code, and internal mail-drop, if applicable
- Attention/Contact person – Name, Title, Department, Phone number, email address
- Purchase Order Number – If applicable
- RMA Number – provided by the Quasonix representative

Please note that Quasonix reserves the right to refuse shipments that arrive without RMA numbers.

# 10 Appendix A – Preset Option

The preset feature operates similar to the stored presets in a car radio. The presence of this option is designated by the characters “PS” and a number (2, 4, 8 or 16) appended to the standard model number. Transmitters with the preset option operate as follows:

1. The potential preset selection pins are pins 4, 5, and 9 on the 15 pin Nano-D connector or pins 4, 5, 9, 16, 17, 18, and 19 on the 21 pin Nano-D connector. Of these pins, up to four may be used for presets depending on the device options. The 15 pin Nano-D (TTL) model can have 2, 4, 8 presets. The 21 pin Nano-D (RS-422) model can have 2, 4, 8, or 16 presets. To see which pins are used for presets and which bits they represent, use the ZY command on the transmitter or refer to the documentation that came with your transmitter.
2. Left floating, (the pins are pulled up to 3.3 VDC internally), a pin represents a “0”, grounded is a “1”.
3. The 0000 state (all pins floating) provides normal operation.
4. The (up to) 15 other states (one or more pins grounded) select one of the presets.
5. Each preset stores a carrier frequency, modulation type, and various configuration values like randomizer, data inversion, differential encoding, etc. These settings can be viewed with the LC (list configurations) command from a terminal.
6. The preset pins are read only at power up. Changing the preset pins after power-on has no effect.
7. The presets are set (in your lab) from the 0000 state, using the “PS” or "SV" command. Storing a preset is done by configuring the device as you wish it to operate, then saving the setup toa particular preset. The save is performed by typing the following command:

   **SV x [name]**

   where x is the preset number (1-15 depending on the options) and name is an optional setup name stored with the setup. Alternatively, issue the “PS” command with a single-digit parameter (1 thru 15). So, “PS 5”, for example will store the current frequency and modulation setting in preset 5. “PS”, with no numeric value after it, reports the state of all presets. The LC command displays names for all setups or, if a setup number is entered, all the settings for that particular configuration.
8. Electrical connection note: The preset pins are connected directly to the FPGA in the unit, so it is important that the voltage on those pins never get outside the range of zero to 3.3 VDC. Voltages outside this range can cause permanent damage. Also, the internal pull-up is through a 25k Ohm resistor inside the FPGA, so it is important that the pins have a high impedance to ground (> 1 M Ohm) when the pins are floating. A true switch closure is ideal, although a transistor switch can be used as long as its “Off” impedance is sufficiently high.

# 11 Appendix B – Acronym List

| Acronym | Description |
|---|---|
| AGC | Automatic Gain Control |
| AM | Amplitude Modulation |
| AQPSK | Variant of Quadrature Phase Shift Keying |
| ARTM | Advanced Range Telemetry |
| AUQPSK | Variant of Quadrature Phase Shift Keying |
| BER | Bit Error Rate |
| BNC | Bayonet Neill-Concelman Connector (RF Connector) |
| BPSK | Binary Phase Shift Keying |
| CD | Compact Disk |
| CPM | Continuous Phase Modulation |
| DB-9 | D-subminiature 9 pin Serial Connector |
| DC | Diversity Combiner |
| DHCP | Dynamic Host Configuration Protocol |
| DPM | Digital Phase Modulation |
| FPGA | Field Programmable Gate Array |
| IF | Intermediate Frequency |
| IP | Internet Protocol |
| kbps | Kilobits per second |
| KHz | Kilohertz |
| LCD | Liquid Crystal Display |
| mbps | Megabits per second |
| MCX | Snap on subminiature connector |
| MHCPM | multi-h Continuous Phase Modulation |
| MHz | Megahertz |
| N | (connector type) Threaded RF connector |
| OQPSK | Offset Quadrature Phase Shift Keying |
| PCMFM | Pulse Code Modulation/Frequency Modulation |
| PM | Phase Modulation |

| Acronym | Description |
|---|---|
| PSK | Phase Shift Keying |
| QPSK | Quadrature Phase Shift Keying |
| RDMS | Receiver DeModulator Synchronizer |
| RF | Radio Frequency |
| RJ-45 | Ethernet Connection Jack |
| RM | Rack Mount |
| RRC | Remote RDMS Client |
| RS-232 | Recommended Standard 232 (Serial Communications) |
| SAW | Sawtooth Wave |
| SDI | System Degradation Indication |
| SOQPSK | Shaped Offset Quadrature Phase Shift Keying |
| SOQPSK-TG | Shaped Offset Quadrature Phase Shift Keying –Telemetry Group |
| TRL | Tracking Loop |
| TTL | Transistor Transistor Logic |
| UDP | User Datagram Protocol |
| UQPSK | Unbalanced Quadrature Phase Shift Keying |
| USB | Universal Serial Bus |
| VAC | Voltage Alternating Current |
| VSWR | Voltage Standing Wave Ratio |
| WAN | Wide Area Network |